The Journal

OF THE

AMERICAN DENTAL ASSOCIATION

CONTENTS

Stephen P. Mallett, D.D.S. ..... Frontispiece

ORIGINAL COMMUNICATIONS

Dangerous Effects of Vitamin D Overdosage on Dental and Paradental Structures.
Hermann Becks, M.D., D.D.S. 1947

Bone Cavities Situated Near the Angle of the Mandible.
Edward C. Stafne, D.D.S. 1969

The Place of the Fixed Bridge in Restorative Dentistry.
F. B. Vedder, D.D.S. 1973

Methods of Procedure in a Diagnostic Service to the Edentulous Patient.
M. M. De Van, D.D.S. 1981

The Early Development of the Human Premaxilla.
Samuel W. Chase, Ph.D. 1991

Correlation and Comparison of Laboratory Findings with the Clinical Evidence of Caries Activity in a Group of Sixty-Six children.
Marshall L. Snyder, Ph.D. 2001

Effect of Various Foods and Cleansing Agents on the Elimination of Artificially Inoculated Yeast from the Mouth.
Holmes T. Knighton, D.D.S. 2012

Action of Oxygen on Chronically Inflamed Gingival Tissue.
Balint Orban, M.D., D.D.S. 2018

Diagnosis and Treatment of Diseases of the Salivary Glands.
Arthur Joseph Barsky, M.D., D.D.S. 2026

President's Annual Report.
Oren A. Oliver, D.D.S. 2046

EDITORIAL DEPARTMENT

The Dentist in the Army 2053

Bibliographical 2056

ASSOCIATION ACTIVITIES

President's Message—War Service Committee—Bureau of Public Relations—Council on Dental Therapeutics—Council on Dental Health—Committee on Legislation—Committee on Economics—Membership Page—Relief Commission and Dental Relief Fund Committee ..... See Special Contents for Association Activities, page 2057

Current Literature 2097
Announcements 2100

ADVERTISEMENTS

Index to Advertisements A-63
Classified Section A-52

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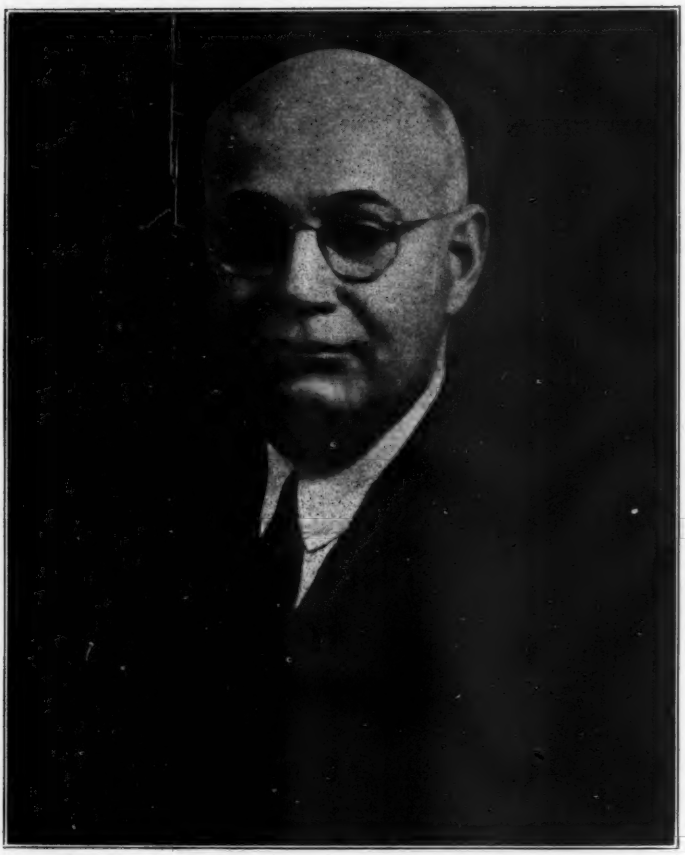

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DANGEROUS EFFECTS OF VITAMIN D OVERDOSAGE ON DENTAL AND PARADENTAL STRUCTURES*

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INTRODUCTION

IT has been known for many years that it is possible to produce characteristic symptoms of a hypervitaminosis by massive doses of vitamin D. In July 1927, shortly after the momentous discovery by Windaus[1] that vitamin D is the result of ultraviolet irradiation of ergosterol, Pfannenstiel[2, 3] reported for the first time that growing rabbits succumbed with the picture of a severe cachexia as the result of peroral administration of large quantities of irradiated ergosterol. Since then, with increasing frequency, clinical and experimental observations emphasizing the potential danger of prescribing vitamin D preparations indiscriminately have been reported. Although some investigators (Cartland, Speer and Heyl,[4] Dixon and Hoyle,[5] Hoyle,[6] Hoyle and Buckland,[7] Lesné and Clément[8] and others) have not been able to find any evidence of toxic effects of vitamin D in their studies, the clinical symptoms of a hypervitaminosis (D) in animals as well as in man are generally recognized today. They consist, for the main part, of weakness and lassitude, nausea, anorexia, polydipsia, polyuria, psychic disturbances, diarrhea, etc. (Reed.[9]) The reader is referred for details to some of the comprehensive reviews of the literature, dealing with the normal and pathologic physiology of vitamin D, by Bills,[10] Cantarow,[11] Eddy and Dalldorf,[12] Funk and Dubin,[13] Glanzman,[14] Jung,[15] Laurens,[16] McCollum, Orent-Keiles and Day,[17] Reed, Struck and Steck,[18] Stepp, Kühnau and Schroeder[19] and others.

*Second prize essay, Chicago Dental Society, February 1942.

From the George Williams Hooper Foundation, University of California.

*Appreciation is expressed to Dr. Agnes Fay Morgan, Professor of the Department of Home Economics of the University of California in Berkeley, who conducted these experiments and placed the animals at our disposal for histological study; also to Dr. Gordon M. Fitzgerald of the Dental Roentgenography Department of the University of California, for his cooperation and courtesy in making the roentgenograms of all the dogs.

Much has been learned during the past ten years with regard to the chemistry of vitamin D and related compounds and their potency and therapeutic applications in rickets, allergic conditions, trichinosis, lead and radium poisoning and certain skin lesions (psoriasis, acne, etc.). However, studies of their toxic effects have been limited mainly to soft tissue lesions, with little consideration of dental and paradental structures. Since the osseous structure is a vital part of the tooth-supporting apparatus, a brief discussion of previous reports dealing with the influence of overdosage of vitamin D on the hard structures of the body follows.

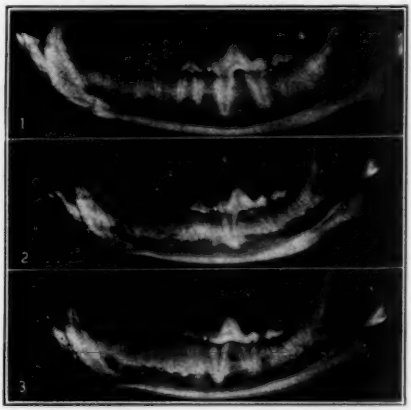


Fig. 1.—Right lower jaws of dogs of Group I. The numbers correspond to the numbers of the animals referred to in the table.

OSSEOUS AND DENTAL CHANGES AS THE RESULT OF VITAMIN D OVERDOSAGE

Previous investigations of the effect of vitamin D overdosage on bone structure must be classified according to the species of animal used, since the resistance to vitamin D, in particular to irradiated ergosterol, varies greatly between different species and even among animals of the same species. (Kreitmair and Moll.[20]) From a survey of the literature, the impression is gained that the majority of studies have been conducted on rats (Collazo, Rubino and Varela,[21, 22] Fang and Miltner,[23] Ham and Lewis,[24] Harris and Innes,[25] Jones and Robson,[26] Katerban,[27] Kellner,[28] Krainz,[29] Raab and Cohn,[30] Schmidtmann,[31] Takahashi,[32, 33] Weinmann,[34, 35] etc.)

The histologic changes in the osseous structures of rats have been described as resembling those found in rickets. Ham and Lewis, for instance, state:

. . . the prolonged and excessive feeding of vitamin D to young rats not only prevents calcification from progressing in a normal fashion, but also results in the development in the long bones of a histological picture identical with one type of rickets . . . the matrix which formed in the bones during the experiment was very poorly calcified; it was concluded that the administration of large amounts of vitamin D inhibited the normal calcification process in bone.

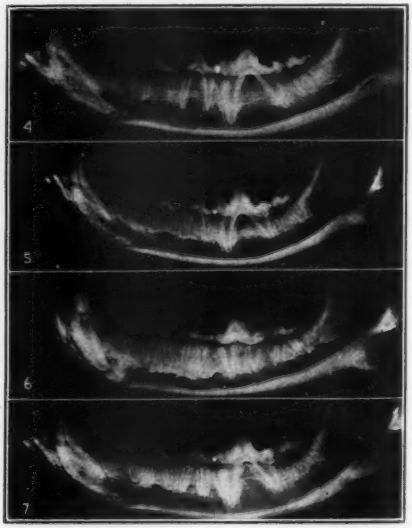


Fig. 2.—Right lower jaws of dogs of Group II.

In other reports, the results simulated an osteodystrophy or osteoporosis.

Weinmann differentiates between typical bone changes of *young* animals

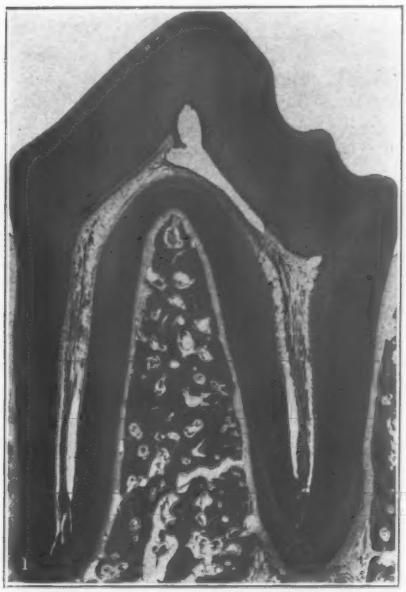


Fig. 3.—Histologic aspect of last premolars of lower jaws of control dog 1 and experimental animals 2 and 3; showing severe sclerosis of paradental bone structure of dogs 2 and 3, accompanied by pathologic calcification of peridental membrane (Spec. 4522, 4525, 4528, Pl. 6803, 7140, 6804). (Embedded in parlodion; stained with hematoxylin eosin; Leitz microsummar 42 mm.; distance from object 1.5 inches; extension of camera 57.5 cm.; ×10.5.)

(rats), which are characterized by an initial osteoporosis followed by overcalcification of several parts of the skeletal structure with intensive endosteal and periosteal bone formation, and those of *adult* animals, in which overcalcification does not occur. In other words, he believes that the age of the animals has to be considered in the interpretation of findings in addition to the dosage and duration of the experiment. Harris and Innes, in a very careful study of rats, state, "X-ray and histological examination of the bones have shown that large doses of vitamin D (with normal diets) stimulate osteogenesis, and a densely calcified overgrowth appears at the growing end of the bone (in contrast with rickets), while in the advanced degrees of the hypervitaminosis, resorption is extensive, and the cortex of the shaft and other 'compact' bone becomes spongy." Similar observations were made by Collazo and co-workers, and, finally, Shohl, Goldblatt and Brown[36] found "no striking abnormalities" in the ribs of rats as the result of vitamin D overdosage.

Furthermore, it is evident that most of these investigators came to the conclusion that overdosage of the irradiated products influences calcium metabolism primarily. Schretter and Halshofer[37] were the first to point out that the main danger of a vitamin D overdosage consists in a toxicosis due to protein decomposition, while Raab and Cohn believe that this toxicosis leads to a fatal blood acidosis. Some of them suspect that the exact mechanism operates the parathyroids.

Experimental studies with other types of animals, as, for instance, mice, cats, rabbits, chickens, guinea-pigs and dogs (Cartland, Speer and Heyl,[4] Fish,[38] Grauer,[39] Kreitmair and Hintzelman,[40] Schmidtmann,[31] Soeur,[41] Taylor, Weld, Branion and Kai,[42] etc.) produced even greater variation of changes in the skeletal structure. For instance, Grauer, and also Taylor, Weld, Branion and Kai, found in guinea-pigs and dogs, respectively, changes similar to osteitis fibrosa (von Recklinghausen). Schmidtmann described the pathologic bone picture produced in rabbits as similar to the osteomalacic form of the human osteitis fibrosa, which is characterized by severe sclerotic bone changes, as reported by Collazo and co-workers; while Soeur speaks of a decalcification of bone tissue with calcium metastases in other organs and a cessation of osteogenesis in young animals similar to those observed in rats. Fractures also have been observed occasionally.

In contrast, Cartland, Speer and Heyl fed young growing puppies diets favorable for the absorption and retention of calcium and phosphorus and then supplemented the vitamin D content with irradiated ergosterol. Doses up to 1,000 times the minimum effective dose of vitamin D were administered. However, these authors did not find any toxic effects upon growth, calcium and phosphorus metabolism or upon the histologic structure or calcium content of the tissues. Fish found roentgenographic evidence in dogs of increased density of bone and continued new formation under the influence of excess of vitamin D.

From a dental point of view, there are very few reports dealing with the effect of vitamin D overdosage. Fish found no difference in the results of chemical analysis of teeth of dogs that had received maximal doses of vitamin D together with calcium carbonate from the results in the controls. Harris and Innes[25] examined rats and found histologically that

> . . . in the teeth, the most noteworthy feature is a remarkable overgrowth of cement, which extends to three or four times its normal thickness, shows much cellular proliferation and invades the marrow spaces of the jaw bone. The inner part of the dentine, to the extent of perhaps half its transverse thickness, is transformed into a distinctive type of secondary dentine, pos-

Fig. 4.—Higher magnification of osseous structure and peridental membrane under bifurcation of premolars in Figure 3 (Pl. 1583, 1578, 1579). (Embedded in parlodion; stained with hematoxylin eosin; Zeiss microtar f=2 cm.; extension of camera 87.5 cm.; ×45.)

sessing a roughly granular and irregular laminated structure and staining intensely with hematoxylin.

A more extensive study of dental tissues has been reported by Weinmann,[34, 35] who examined the results of hypervitaminosis (D) in young and adult rats. While the young experimental animals developed an overcalcification and new formation of cementum of molars as reported previously by Harris and Innes, such changes could not be observed in the adult rats. The pulp tissue of anterior teeth, but not of the molars of both groups, showed the formation of pulp stones.

In summarizing previous reports, it can be stated that there seems to be a great variation, if not a lack of confirmation, in the results of individual reports. In fact, changes in the osseous structure varied so greatly that a number of investigators found the typical picture of rickets, while others observed the vastly different disease of osteitis fibrosa (von Recklinghausen). Several reports denied that any changes could be found in osseous structure, while other investigators described severe overcalcification and osteosclerosis as characteristic for hypervitaminosis (D). It is evident that, in many instances, the experimental arrangements varied so greatly that the results cannot be compared. The main reasons for these discrepancies are that different sources and quantities of vitamin D were used, with a wide variation in basal diets, amounts of other vitamins and duration of experiment. One of the most important factors seemed to be the variation of response among different species of test animals and differences in their ages.

Vitamin D is known to exist in several

DISTRIBUTION OF ANIMALS AND EXPERIMENTAL DATA

Group	Dog	Sex	Duration of Experiment Days	Age in Days		Vitamin A/Kg. Body Weight	Vitamin D/Kg. Body Weight	U.S.P. Units A/Kg.	U.S.P. Units D/Kg.	Source of Vitamin A	Source of Vitamin D
				When Placed on Diet	At Necropsy						
Control	1	♂	291	39	330	Optimum	Optimum	800	72	Halibut liver oil	Tuna liver oil
Group	2	♀	281	39	320	Optimum	Excessive	800	10,000	Halibut liver oil	Irradiated ergosterol
I	3	♀	291	39	330	Optimum	Excessive	800	10,000	Halibut liver oil	Irradiated ergosterol
Control	4	♂	281	39	320	Excessive	Optimum	10,000	72	Halibut liver oil	Halibut liver oil
	5	♀	281	39	320	Excessive	Excessive	10,000	10,000	Tuna liver oil	Tuna liver oil
Group II	6	♀	291	39	330	Excessive	Excessive	10,000	10,000	Halibut liver oil	Irradiated ergosterol
	7	♂	281	39	320	Excessive	Excessive	10,000	10,000	Halibut liver oil	Irradiated ergosterol

Litter I: Dogs 1, 3 and 6.
Litter II: Dogs 2, 4, 5 and 7.

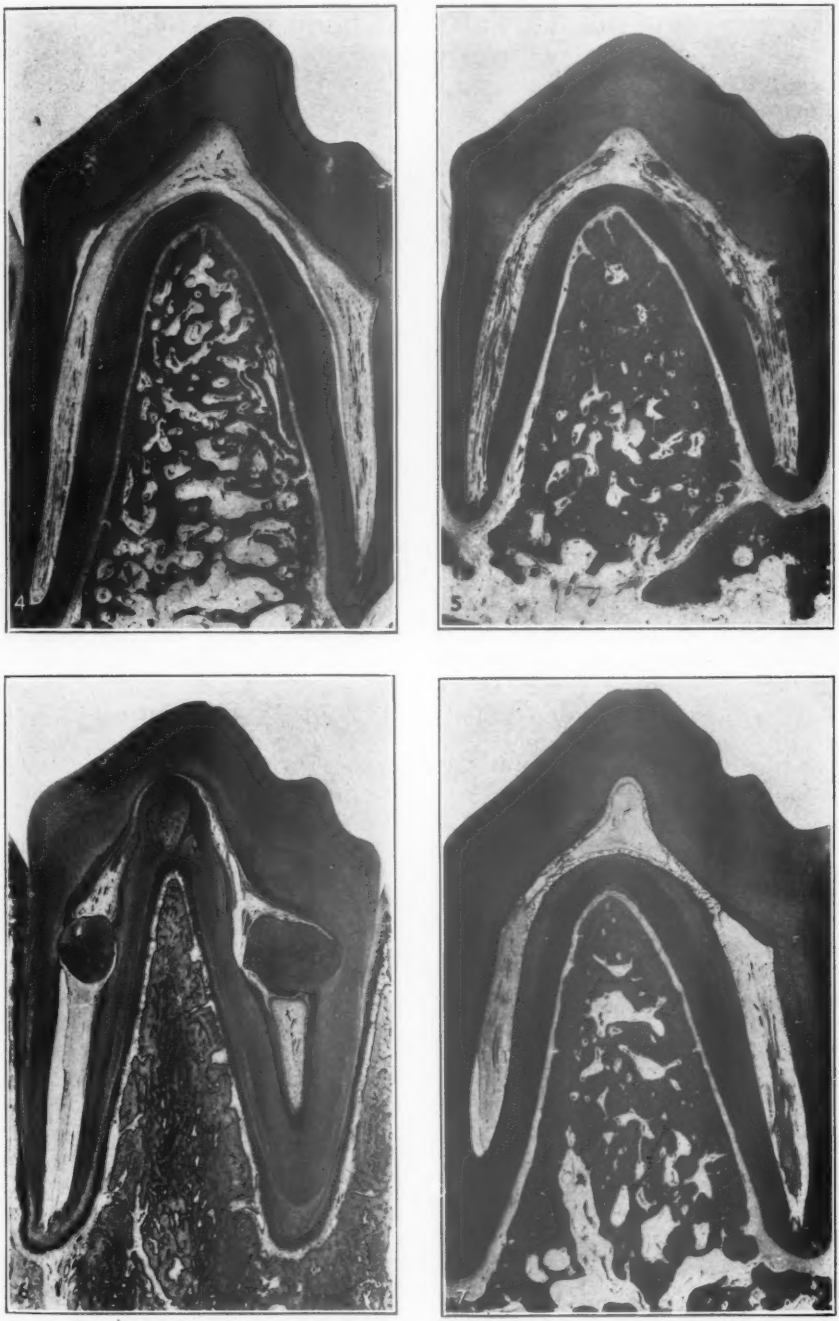


Fig. 5.—Premolars of lower jaws of dogs 4, 5, 6 and 7; showing difference in paradental bone structure, pathologic calcification of peridental membrane and formation of pulp stones in dog 6 (Spec. 4531, 4540, 4537, 4534, Pl. 6640, 6805, 6639, 6806). (Embedded in parlodion; stained with hematoxylin eosin; Leitz microsummar 42 mm.; distance from object 1.5 inches; extension of camera 57.5 cm.; ×10.5.)

forms, each again having different properties and chemical composition. It is therefore of utmost importance in any experimental work with various types of the "antirachitic vitamin" to study in detail the possible effectiveness of their application and also their toxicity. As far as the species of animal is concerned, rats are, of course, suitable for experimental work because of their early maturity and rapid reproduction. On the other hand, dogs react differently than rats to several dietary factors and the results resemble more closely the diseases produced by similar means in human beings. Especially in vitamin D studies, dogs are probably more suitable because their rachitic changes resemble more closely those of the infant than do those of any of the other experimental animals.

Because of the lack of knowledge and of specific information on the effects of the different forms of vitamin D and their overdosage on dental and paradental structures, it was decided to undertake such a study and to use the dog as the test animal.

EXPERIMENTAL MATERIAL

For the purpose of this report, two litters of thoroughbred cocker spaniels were used and divided into two groups as shown in the accompanying table.

Group I, consisting of dogs 2 and 3, received excessive amounts (10,000 U.S.P. units) of irradiated ergosterol and optimum amounts (800 U.S.P. units) of vitamin A. The control dog 1 remained on an optimum vitamin A and D intake; i.e., 800 and 72 U.S.P. units, respectively. The source of vitamin D for this control dog was tuna liver oil, while halibut liver oil was used for all three dogs of Group I as the source of vitamin A.

Group II consisted of three experimental animals (dogs 5, 6 and 7) and the control dog 4. In contrast to Group I, all these animals received excessive amounts of vitamin A; i.e., 10,000 U.S.P. units. In addition to this, the control dog 4 obtained optimum amounts of halibut liver oil as a source of vitamin D, while one (dog 5) received excessive amounts of vitamin D (10,000 U.S.P. units) through tuna liver oil, and the other two (dogs 6 and 7) through irradiated ergosterol. The reason for the addition of excessive amounts of vitamin A was the previous experience by Morgan and his co-workers[43, 44, 45] that large excess of vitamin A may decrease the harmful effect of overdosage of vitamin D, especially of irradiated ergosterol. Therefore, it was advisable to study this possible action of vitamin A.

With regard to the basal diet and other constituents, a purified diet was chosen which preliminary work had shown was adequate from every point of view for cocker spaniels and especially with regard to the proportion of calcium and phosphorus. (For detailed information on dietary composition, growth curves, etc., of these animals during the experiment, reference should be made to Morgan.[44])

At the beginning, the mouths and teeth of all dogs were carefully examined, and they were regularly inspected during the experimental period. All dogs were placed on their respective dietary régime when they were 39 days old and remained on it for 281 and 291 days, as shown in the table. Their ages were therefore 320 and 330 days at the time of necropsy. Chemical analyses of blood serum, roentgenograms of long bones, complete necropsy findings and changes in general appearance and behavior of the experimental animals are to be reported separately. From a dental point of view, the clinical, roentgenographic and histologic aspects of the jaws and teeth indicated extraordinary changes, which must be attributed to the excessive doses of vitamins A and D. At the

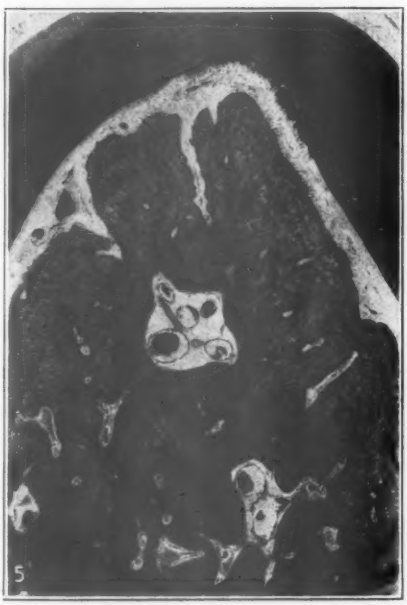


Fig. 6.—Higher magnification of osseous structure and peridental membrane under bifurcation of premolars of dogs 4, 5 and 7 in Figure 5 (Pl. 1582, 1584, 1581). (Embedded in parlodion; stained with hematoxylin eosin; Zeiss microtar f=2 cm.; extension of camera 87.5 cm.; ×45.)

time of necropsy, the heads and jaws were dissected, roentgenographed and prepared histologically.

CLINICAL AND ROENTGENOGRAPHIC ASPECTS OF JAWS AND TEETH

For the purpose of comparison, the roentgenograms of the right lower jaws of the dogs in Group I are reproduced in Figure 1 and those of Group II in Figure 2. The numbers 1 to 7 of Figures 1 and 2 indicate the dog numbers as in the table.

In contrast, the jaws of dogs 2 and 3 offer an entirely different picture. In the first place, it can be noted in Figure 1 that their size in width and length lags far behind the control. That roots are greatly malformed is especially evident in dog 2. In general, the teeth are much smaller and their alinement is very irregular. Dog 2 shows evidence of multiple pulp stones in the canine and large molar teeth, and it appears that the excess of vitamin D, i.e. irradiated ergosterol, has affected this animal to a greater extent than dog 3. Both animals had extensive calculus formation at the end of the experimental period and gave the typical roentgenographic appearance of a generalized osteosclerosis, most marked in dog 2.

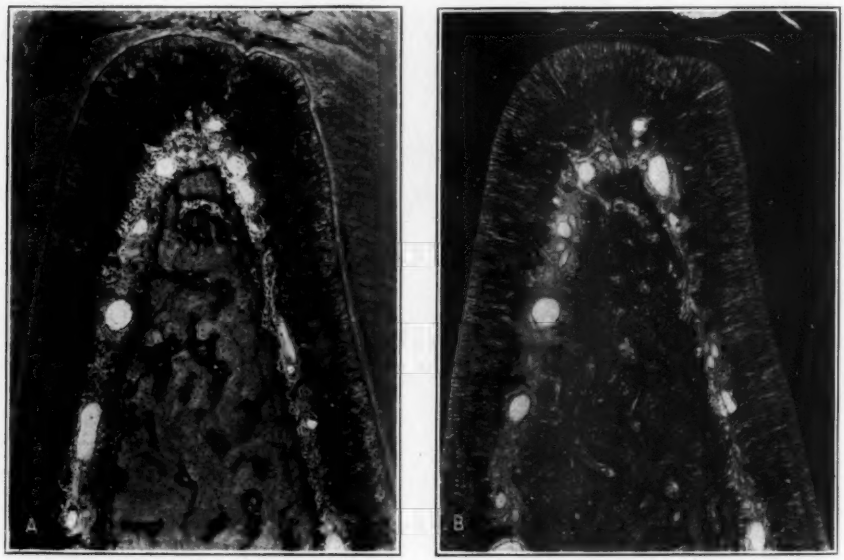


Fig. 7.—Higher magnification of pathologic calcification under bifurcation of premolar of dog 6. A, staining with hematoxylin eosin. B, staining by Bielschowsky's silver impregnation method (Spec. 4537, Pl. 7374, 7373). (Zeiss Homal II, apochromatic 6; extension of camera 84 cm.; ×75.)

Group I.—The control animal, No. 1 (Fig. 1), shows a well-developed jaw, with large and strong teeth. The roots are straight, without any deformities, and the paradental bone structure has an even distribution of trabeculae. There are no pulp stones visible. The alinement of all teeth is regular and the gum tissue shows no pathologic changes.

Group II.—Dog 4 (Fig. 2), who served as a control, is, as far as tooth, bone and jaw development is concerned,

in every way comparable to dog 1 (control of Group I). In fact, these structures appear even stronger and larger, a condition which may be related to the additional amounts of vitamin A. The development and roentgenographic appearance of the jaws of dogs 5, 6 and 7, however, differ greatly. The teeth of all three are much smaller than those of the control and are irregularly alined. The size of the teeth and the occlusion of dog 7 approach those of dogs 1 and 4 more closely than any of the others. Nearly

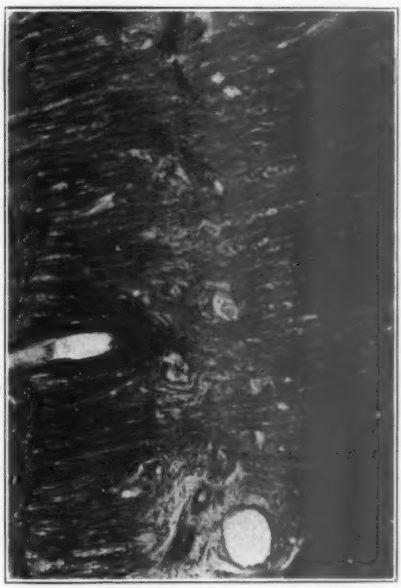


Fig. 8.—Dog 6: Calcification of peridental membrane fibers as result of excess of vitamin D intake (Spec. 4537, Pl. 2173). (Embedded in parlodion and stained by Bielschowsky's silver impregnation method; Leitz eyepiece 8, apochromatic 16 mm.; extension of camera 52.5 cm.; ×200.)

all the teeth of dog 6 show evidence of pulp stones, which are absent in dogs 5 and 7. While the bone structure of dogs 5 and 7 appears very dense, dog 6 seems to have an advanced osteosclerosis.

HISTOLOGIC ASPECT

The marked differences histologically in the roentgenographic appearance of the jaw bone structures and the teeth of all seven animals were examined. Serial sections of 10-12 micra thickness were stained routinely with hematoxylin and eosin. For comparative purposes, central sections of the last premolars and their surrounding structures are demonstrated in survey photomicrographs for Group I in Figure 3 and Group II in Figure 5. Magnifications of the osseous tissue and peridental membrane under the bifurcation are given for greater detail in Figures 4 for Group I, and 7 and 8 for Group II. All comparative photomicrographs are of the same magnification. The numbers in each figure represent the number of the dog.

Group I.—A comparison of the teeth and osseous structure of dogs 1, 2 and 3 reveals decided differences. The premolars of dogs 1 and 3 seem to be of similar size, while dog 2, as already mentioned in the discussion of the roentgenographic aspect, has greatly malformed crowns and roots. There is no gingival inflammation or pocket formation.

The bone structure of dog 1 (Fig. 3) shows an even distribution of marrow cavities. Resorption and new formation of bone as evidenced by the presence of osteoclasts and osteoblasts (Fig. 4) keep balance. The peridental membrane is of an even width. In contrast, it is found that dogs 2 and 3, which were fed an overdosage of irradiated ergosterol, have a characteristic generalized osteosclerosis. By accelerated formation of new bone structure, the marrow cavities have been greatly decreased in size and eliminated in many instances. This is especially evident in Figure 4. Neo-osteogenesis is pronounced. Outstanding for dogs 2 and 3 is an increased deposition of a cementum-like substance which occupies a large part of the peridental membrane.

These deposits increase in width toward the marginal area (Fig. 3) and vary throughout in degree of calcification (Fig. 4). Similar depositions that can be seen in the small marrow cavities indicate, through their affinity to hematoxylin, their highly calcified nature. The dental structures do not present any definite sign of increased calcification, except that multiple pulp stones were formed in all teeth of dogs 2 and 3. These were most pronounced in dog 2. In several teeth of these animals, there is an indication that the recently deposited dentin may be more highly calcified than other parts of the teeth because of darker staining of the dentin layer adjacent to the odontoblasts. However, this is not uniform. (Fig. 3.) The enamel, of course, is absent as the result of the decalcification of the specimen for histologic preparation.

Group II.—As shown in the Table, dogs 5, 6 and 7 received excessive amounts of vitamins A and D in various forms. The photomicrographic survey of the premolars offers an interesting comparison. (Fig. 5.) Control dog 4 shows a distribution of bone trabeculae similar to that of control dog 1 in Group I, with small and larger marrow cavities and an even width of the peridental membrane space. There is normal physiologic resorption and new formation of bone, indicating the adequacy of the diet for the growth and physical health of these animals. However, there are striking differences in the other three animals.

Dog 5, which received excessive amounts of vitamins A and D through tuna liver oil, developed an osseous structure which, at the first glance, appears to be superior to that of the control, because of its greater density and much smaller marrow cavities. However, the teeth are decidedly smaller and pathologic calcification is found under the bifurcation, near the cemento-enamel junction, and on the surface of the apical third of the root. (Figs. 5 and 6.) As seen in Figure 6, there also seem to be localized areas of overcalcification of bone and a pathologic deposition in the marrow cavities.

With the exception of the size of teeth, which are much larger in dog 7, the effects of vitamin D overdosage are similar in dogs 5 and 7. The distribution of bone and marrow cavities is

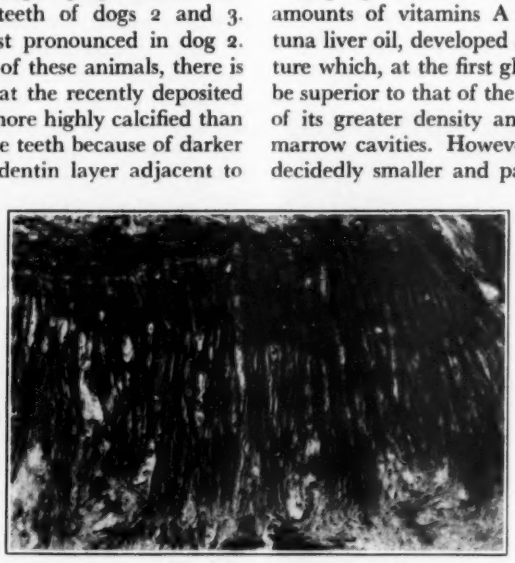


Fig. 9.—Dog 6: Surface of cementum of premolar with highly calcified peridental membrane fibers (Spec. 4537, Pl. 2175). (Embedded in parlodion and stained by Bielschowsky's silver impregnation method; Leitz eyepiece 8, apochromatic 16 mm.; extension of camera 87.5 cm.; ×325.)

similar, as is the pathologic calcification in the cementum, peridental membrane space and marrow cavities. However, these changes are far less pronounced than in dogs 2 and 3 of Group I (Figs. 3 and 4), in spite of the fact that dogs 5 and 7 had the same excess of vitamin D, but larger amounts of vitamin A. In fact, it appears that this addition of vitamin A in Group II is responsible for the mitigated form of the pathologic changes. The hemorrhages in the pulp tissue of dog 5 (Fig. 5) do not seem pathognomonic for the excess of vitamin A or D.

An exception to dogs 5 and 7 is seen in dog 6. Here, marked pathologic calcification has taken place. As stated above, the jaw bone is very sclerotic and the teeth are greatly malformed and smaller than those of the control. Histologically, most marrow cavities are entirely closed by increased bone formation, and in many of them where this had not been accomplished as yet, amorphous deposits, which seem highly calcified and stain dark blue, almost black, fill the entire remaining cavity.

The cementum has greatly increased in thickness and the calcified deposits on the surface of the cementum follow the direction of the peridental membrane fibers. An illustration of this highly pathologic calcification under the bifurcation of the premolar in Figure 5 is given under high magnification in Figure 7. Two stainings were employed: Figure 7, A demonstrates the lesion as seen with hematoxylin and eosin staining, and Figure 7, B with the Bielschowsky silver impregnation method. In both illustrations, the highly calcified nature of the cementum-like substance can be noted. The surface of the bone structure shows the same changes. Figure 7, B indicates the true character of this structure to be a progressive calcification of Sharpey's fibers, which has become so pronounced in some areas that an ankylosis between bone and tooth has formed. The layers closest to the tooth surface seem to be less calcified than those near the peridental membrane.

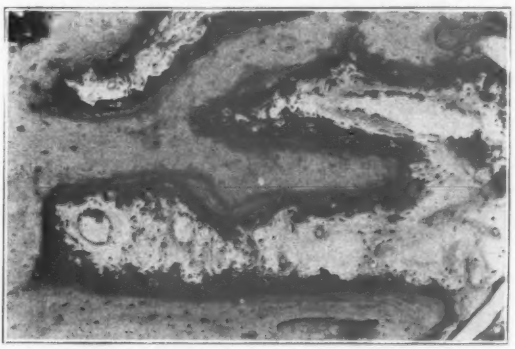
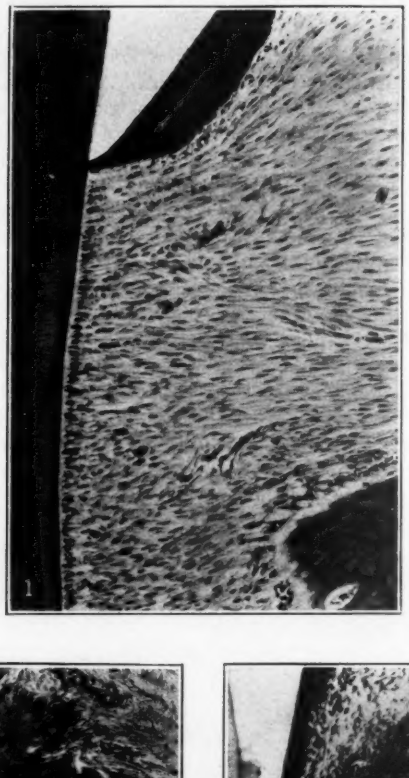


Fig. 10.—Deposition of amorphous highly calcified substance on surface of bone trabeculae (Spec. 4537, Pl. 2535). (Embedded in parlodion and stained with hematoxylin eosin; Zeiss Homal VI; apochromatic 10; extension of camera 78.2 cm.; ×185.)

The calcification process is still further illustrated in the higher magnifications of Figures 8 and 9. Here, the highly calcified fibers can be followed from the "fiber bone" into the cementum. Figure 9 demonstrates the calcified Sharpey's fibers, as they are embedded in the cementum ground substance, a condition which it is very difficult to demonstrate



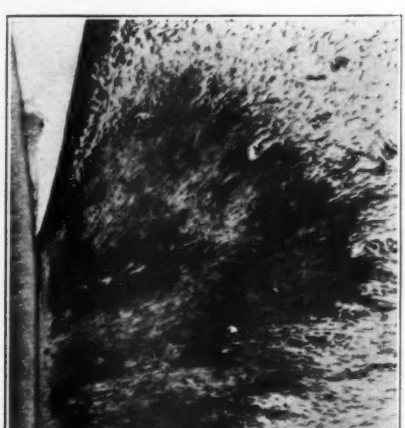


Fig. 11.—High magnification of section showing pathologic calcification of subepithelial connective tissue and peridental membrane of dogs 2 and 3 in contrast to control dog 1 (Group I) (Spec. 4522, 4525, 4528, Pl. 2340, 2341, 2344). (Embedded in parlodion and stained with hematoxylin eosin; Leitz eyepiece 8, apochromatic 16; extension of camera 37.55 cm.; ×150.)

to this extent under normal conditions in human and animal material.

From the standpoint of variation in the degree of pathologic calcification in the animals in Group II, it appears that dog 5 showed the least change, while dog 6 had the most severe reaction. This may be best illustrated by the extent of deposition in the peridental membranes near the cemento-enamel junction of dogs 5 and 6, respectively. The reason for less change in dog 5 may be sought in the source of vitamins A and D, which was tuna liver oil, while dog 6 received halibut liver oil and irradiated ergosterol, as shown in the table. Another fact may have contributed to the extreme reaction of dog 6. This animal, the runt of the litter, showed throughout the experiment an exaggerated response to the excess of vitamin D. It is possible that the tolerance of this dog to vitamin D was much lower, which may explain the difference in reaction.

A word may be said about the comparative changes with regard to calcification processes between Groups I and II, best illustrated by Figures 11 and 12. Here, the degree of calcification of connective tissue at the cemento-enamel junction of all seven animals is demonstrated. If dog 6 in Figure 12 is temporarily ruled out for the reasons stated, it appears that the changes are most severe in dogs 2 and 3, which received an optimum amount of vitamin A and an excess of vitamin D in the form of irradiated ergosterol. Next in severity is dog 7. However, a comparison of dogs 2 and 3 with dog 7 shows a decided difference in that the pathologic changes are far less pronounced. This can be explained only on the basis of the excess of vitamin A in dog 7, because otherwise the sources of vitamins A and D are the same (halibut liver oil and irradiated ergosterol). These morphologic changes confirm the findings of Gross-Selbeck[46] and Morgan[44, 45] that the injurious effects of a vitamin D overdosage on growth and physical health of growing rats can be prevented by large doses of vitamin A. Thoenes[47] believes that the use of excessive amounts of vitamin D leads to a condition of the organism approaching an avitaminosis (A) and that such a vitamin D overdosage apparently requires large amounts of vitamin A in order to prevent harm. The rather mitigated forms of pathologic calcification in Group II in contrast to Group I bear out these observations. As stated previously, the least changes are found in dog 5 (Fig. 12), which received tuna liver oil as the source of vitamins A and D; which seems to account for the difference in response. In the control dogs 1 and 4 (Figs. 11 and 12), there were pathologic manifestations in these areas.

Three more photomicrographs illustrate the marked degree of calcification of the free margin of the gum, which was obtained under the most extreme conditions. As seen in dog 6 in Figure 13, the gingival papilla is partly calcified, and it was clinically possible to remove white calcified granules from these areas. In the interproximal space, not only has the bone structure become sclerotic, but the amorphous deposits in the peridental membrane spaces have become so extensive that the sides join and almost fill the entire gingiva. (Fig. 14.)

One more very interesting and rather important pathologic change should be mentioned, the formation of pulp stones in nearly every tooth of dog 6 and in several teeth of dogs 2 and 3. Typical representatives are found in Figure 5. In some teeth, the connective tissue of the pulp stains readily with hematoxylin, which indicates a rather high mineral content, as seen in Figure 15. There is also a large amount of vacuolization in the odontoblastic layer as well as in the center of the pulp. It is, of course, natural to raise the question as to whether

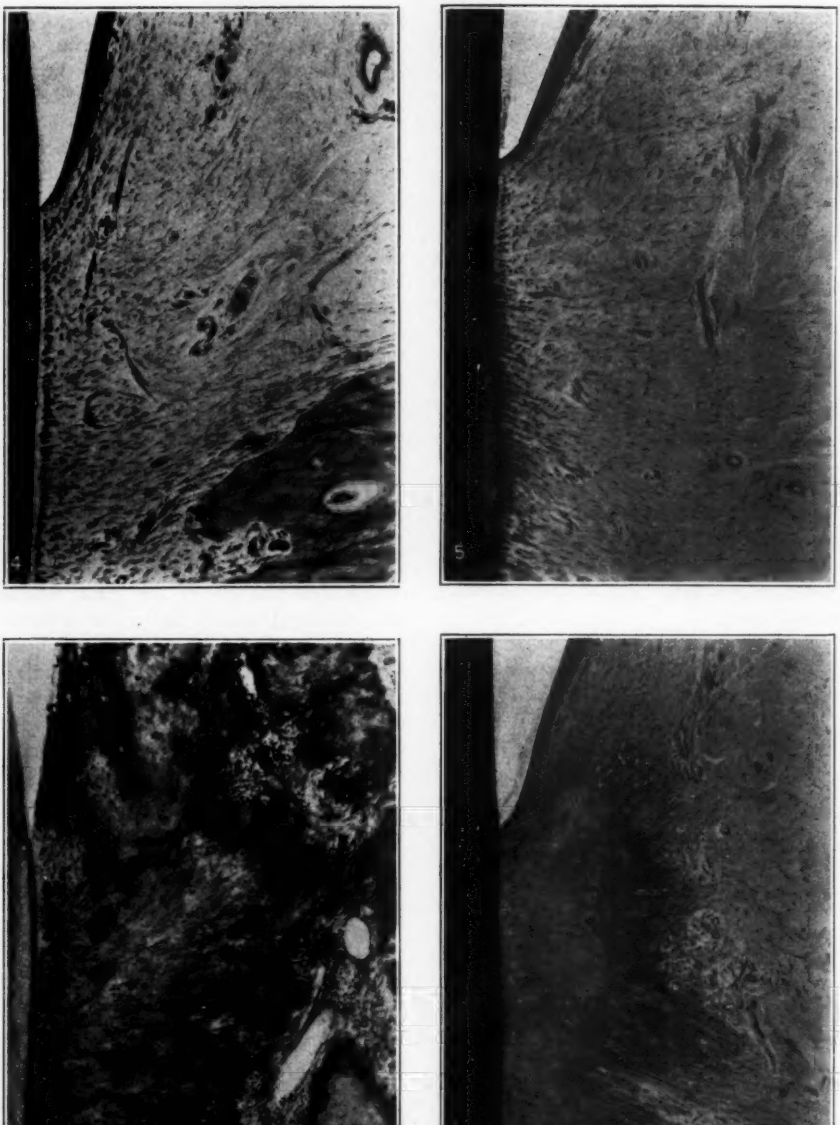


Fig. 12.—High magnification of section showing paradental calcification in dogs 4, 5, 6 and 7 (Group II). Maximum changes were observed in dog 6, while dog 5 was least affected. The control dog 4 showed freedom from any pathologic process (Spec. 4531, 4534, 4538, 4540, Pl. 2342, 2343, 2339, 2171). (Embedded in parlodion and stained with hematoxylin eosin; Leitz eyepiece 8, apochromatic 16; extension of camera 37.55 cm.; ×150.)

pulp stones occurring in human beings could be of the same etiology. There appears little doubt that the excess of irradiated ergosterol is primarily responsible for them in these animals.

In more advanced stages, amorphous precipitation occurs, the affected areas becoming enclosed by odontoblasts, with regular dentin beginning to form around them. These "denticles" continue to grow until they join the walls of the pulp (Fig. 16), and every one of them shows, even in the last stage, evidence of the primary precipitation in the center. (Fig. 17.) This calcification process and precipitation does not seem to occur in tissues that have undergone degenerative changes or even necrosis, but is found anywhere in healthy, normal connective tissue or on the surface of the hard structures; i.e., bone or teeth, in the absence of primary injury.

Fig. 13.—Pathologic calcification of free margin of gum tissue in dog 6 (Spec. 4526, Pl. 1580). (Embedded in parlodion and stained with hematoxylin eosin; Leitz microsummar 42 mm.; distance from object 1.5 inches; extension of camera 90.0 cm.; ×18.)

Fig. 14.—Dog 6: Pathologic calcification of peridental membrane (cementum hypertrophy?) and gum tissue with partial degeneration of enamel epithelium. The bone appears highly osteosclerotic, with nearly all marrow cavities closed (Spec. 4538, Pl. 2330). (Embedded in parlodion and stained with hematoxylin eosin; Zeiss microtar f=4.5 cm.; extension of camera 97.5 cm.; ×21.0.)

SUMMARY AND CONCLUSION

Although, in the past, natural fish oils were believed to have little toxic effect on human beings, warnings against their overdosage have become more frequent of late, especially with respect to the irradiated products. The numerous reports dealing with the effect of vitamin D overdosage on various anatomic structures gives evidence of the interest of a large

number of investigators in the determination of optimum levels and the establishment of correct dosages of vitamin D for human beings, as well as for animals, so that harmful effects may be avoided. Unfortunately, a general agreement has not been possible, and much more work is required to gain knowledge of the possibilities and limitations of this drug for optimum health and the treatment of the sick.

Former studies of the effect of overdosage on the skeletal structure were limited mainly to histologic examinations of tibias, ribs and humeri of rats and other animals. In many instances, only roentgenographic findings were reported. The results obtained were by no means uniform, varying from definite softening of bone structure to extreme osteosclerosis and pathologic calcification of connective tissue. This obvious discrepancy has been traced to the fact that varying forms and quantities of vitamin D were used and that the ages and species of animals differed greatly. The duration of the experiment, as well as the basal diet and the presence or absence of other vitamins, must also be considered a vital factor. With regard to the physiologic action of vitamin D in relation to dental tissues, even less is known. In spite of this fact, the indiscriminate prescription of vitamin D concentrates in dental practice to prevent or arrest oral disturbances has reached alarming proportions and is increasing. Furthermore, clinical and laboratory studies have not provided any definite proof as yet that dental caries can be influenced by the administration of vitamin D in any form, and we are still far from understanding its physiologic action on osseous structure. Its prominent place in the treatment of rickets is, of course, well known. However, in spite of this, it cannot be said that the problem of rickets has been completely solved. If we agree that even in such a distinct clinical and pathologic entity as rickets, there is much to be learned about the dosage of vitamin D and its relation to the hormonal system, especially to the thyroid and parathyroids, it is not difficult to understand that its therapeutic value in paradental disorders, with special regard to the osseous tissue, has not been established as yet.

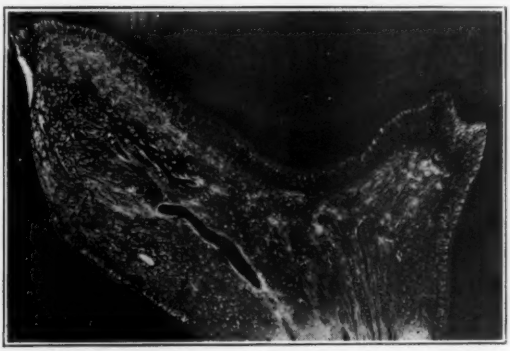


Fig. 15.—Section showing high mineral (calcium?) content of connective tissue of pulp, indicated by affinity to hematoxylin (Spec. 4547, Pl. 7377). (Embedded in parlodion and stained with hematoxylin eosin; Zeiss microtar f=1 cm.; extension of camera 57.6 cm.; ×61.)

It appears from clinical and laboratory experience that vitamin D is essen-

tial for normal tissue growth and development and also for teeth and their surrounding structures. However, with the exception of the experiments of Harris and Innes and Weinmann, little is known as to how much harm can be done to the teeth and jaw by overstepping optimum levels of vitamin D.

The combined roentgenographic and histologic study of the jaws and teeth of the seven dogs reported here permits an interesting insight into the effect of optimum and excessive doses of various forms of vitamin D on osseous and dental tissues.

Since dogs in many ways react differently from rats to several dietary measures, and, also, since they exhibit diseases more closely resembling those of human beings resulting from dietary disturbances, two litters of thoroughbred cocker spaniels were used for this experiment. Five animals received excessive amounts of fish oil and irradiated ergosterol, while two were kept as controls. The teeth and mouths were inspected regularly during the experiment, which averaged 308 days. After necropsy, the right lower jaws were roentgenographed and then prepared histologically.

The results may be summarized as follows:

1. Clinical and roentgenographic aspect: In spite of overdosage of vitamin

Fig. 16.—Large pulp stone (denticle) in premolar of dog 6. The central area consists of an amorphous deposition of highly calcified material. The other part of the denticle consists of regular dentin structure (Spec. 4538, Pl. 1588). (Embedded in parlodion and stained with hematoxylin eosin; Zeiss microtar f=2 cm.; extension of camera 100.0 cm.; ×51.0.)

Fig. 17.—Magnification of central section of pulp stone in Figure 16 (Spec. 4538, Pl. 1587). (Zeiss Homal VI, apochromatic 10; extension of camera 82.6 cm.; ×192.0.)

D, the growth and development of jaws and teeth of all experimental animals lagged far behind the controls. In both, malformation was accompanied by malocclusion.

(a) Optimum amounts of vitamins A and D, in the form of halibut and tuna liver oil, respectively, help to produce sound and strong jaw bones and teeth in growing dogs.

(b) Optimum amounts of vitamin D with excessive amounts of vitamin A seem to be still more favorable for growth and development of jaw bone and dental structures.

(c) Excessive amounts of vitamin D in the form of irradiated ergosterol, with optimum amounts of vitamin A, lead to a generalized osteosclerosis of the jaw bone and paradental bone structures. Teeth are greatly malformed and in malocclusion. Formation of multiple pulp stones occurs.

(d) Excessive amounts of vitamins D and A, if derived from tuna liver oil, seem to be less dangerous from the standpoint of pathologic bone formation and the degree of calcification than when the vitamin D is derived from irradiated ergosterol.

(e) Excessive amounts of vitamins A and D in the form of halibut liver oil and irradiated ergosterol, respectively, also produce an osteosclerosis. However, this is far less pronounced than when vitamin A is present in optimum amounts. In extreme forms, multiple pulp stones are found.

2. Histopathologic aspect: The changes in jaws and teeth, as observed roentgenographically, were confirmed by histologic examination. This indicates that the excessive amounts of vitamin D not only interfered with the growth and development of these hard structures, but also that they damaged severely the connective tissue parts of the teeth and their surrounding structures.

(a) Optimum amounts of vitamins A and D lead to the formation of sound bone structure, with an even distribution of trabeculae and marrow cavities. Resorption and new formation of bone keep balance. There is no inflammation of the gingiva.

(b) Excessive amounts of vitamin A and optimum levels of vitamin D produce the same histologic bone picture as under (a), which seems to emphasize the fact that the excess vitamin A favors, rather than inhibits, growth and development of jaws and teeth. As mentioned in the description of the jaw roentgenograms, it appears that, under this influence, jaws and teeth are much stronger than when only optimum amounts of both vitamins are used.

(c) Optimum amounts of vitamin A with an excess of vitamin D (irradiated ergosterol) produce: (1) an osteosclerosis of the jaws, which is characterized by increased osteoblastic activity, the marrow cavities being either closed by increased bone formation or the deposition of an amorphous highly calcified material; (2) severe pathologic calcification in the peridental membrane and the gum tissue, with a partial degeneration of the enamel epithelium; (3) a cementum-like substance on the surface of the roots, leading, in many instances, to ankylosis between tooth and bone; (4) multiple pulp stones, which may give an important clue to the etiology of this disturbance in human beings; (5) extensive formation of calculus.

(d) Excessive amounts of A and D in the form of halibut liver oil and irradiated ergosterol lead to pathologic changes similar to those described under (c). However, they are far less pronounced.

(e) If tuna liver oil is used in excess as the source of A and D, the pathologic processes appear only in a very mitigated form. Therefore, the natural fish oils seem to be far less dangerous than the irradiated products. Again, the presence of excess amounts of vitamin A further

decreases the injurious effects of an excess of vitamin D.

These extreme pathologic changes appear to be similar to certain clinical and roentgenographic observations in human beings, and it must be concluded that hypervitaminosis (D) presents a potential danger not only to the physical health, but also to the skeletal structures and to the jaws and teeth in particular.

Finally, a word of warning must be voiced to the dental profession and to the general public against the frequent recommendation of and the routine use of vitamin D preparations for the arrest of dental ailments without a better understanding of their composition, dosage and toxicity level. The warning that was recently voiced by Schour[48] against the employment of calcium therapy in dentistry must be extended also to vitamin D therapy. Too much enthusiasm in biologic therapy is very dangerous.

The fact that animals develop pronounced pathologic calcification of various organs and tissues as the result of experimental hypervitaminosis (D) with severe pathologic changes in the oral cavity and jaws should indicate to us that the indiscriminate use of this drug may cause permanent harm to our patients.

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BONE CAVITIES SITUATED NEAR THE ANGLE OF THE MANDIBLE

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THIS report is concerned with observations made in thirty-five instances in which bone cavities have been seen near the angle of the mandible. No opportunity has been afforded to make microscopic examination of the cavities or of their contents, but the similarity in roentgenologic appearance and consistent location suggest a definite entity with a common etiologic factor. The thirty-five cavities were seen in thirty-four patients. The average age of the patients was 53.47 years, an average well above that of patients who are seen routinely in the dental section. The youngest was 33 years of age, the oldest, 72. There were twenty-eight men and six women. That there is such a preponderance of cases among men is an interesting finding.

All the cavities were found incidentally on complete roentgenologic examination in which only intra-oral films were used. When satisfactory pictures that included the borders of the cavity could not be obtained, extra-oral lateral jaw pictures were made. The cavities, which varied from 1 to 3 cm. in diameter, were situated below the mandibular canal in the region as far forward from the angle as the third molar. Most of them appeared to be confined to the cancellous portion of the bone, but many, and particularly those of larger size extending to the outer surface of the bone, interrupted the continuity of the inferior border of the mandible, so that, on palpation, an indentation could be clearly felt (Fig. 1).

From the Section on Dental Surgery, Mayo Clinic, Rochester, Minn.

The cavities were either round or oval. When oval, the largest dimension was parallel to the long axis of the body of the mandible. From roentgenographic evidence, it is clear that the walls of the cavity are in general denser and thicker than those seen in bone cavities produced by epithelial-lined cysts of dental origin.

In one instance, the condition was bilateral (Fig. 2). Unfortunately, a careful examination of the opposite side of the mandible was not made except in the more recent cases that have been observed. Such a measure, in all of them, might have revealed other instances in which both sides were involved. Seventeen of the cavities were on the right and eighteen on the left side of the mandible.

An opportunity again was had to make roentgenograms of five of the cysts after intervals of approximately five to seven, seven to ten and eleven years, respectively. In no instance was there any change or increase in size of the cavity.

Since the cavity and its contents have not been examined microscopically, any discussion as to its possible nature must be a matter of conjecture. Some of the conditions which such a cavity may suggest are epithelium-lined cyst, particularly in the jaws, some forms of polycystic disease, solitary cyst and congenital defects. The first two conditions mentioned probably can be dismissed without discussion, since the origin of an epithelium-lined cyst below the mandibular canal is improbable, and a general physical examination of the patients who have had these bone cavities did not reveal any evidence of polycystic disease.

Solitary bone cysts have been noted long since in bones other than the jaw. They develop during the growing period, and rarely after adult life is reached. The general opinion is that they occur as a result of trauma. Phemister and Gordon spoke of four main hypotheses that have been advanced to account for their occurrence: They are the result of (1) degenerated tumor; (2) localized fibrocystic disease; (3) a hematoma in the bone marrow, or (4) infection. They reported two cases in each of which polymorphonuclear leukocytes and a few giant cells. In the bone immediately surrounding the area, there may be alternating regions of resorption and deposition of bone. Witting and Gillespie reported a case of benign solitary bone cyst, which healed spontaneously, in the fibula of a new-born child.

The occurrence of solitary bone cysts in the jaw, similar to those in other bones, has been reported by Blum, Ivy and Curtis, Smith and Barrows and Thoma. In all of these cases, it was assumed that

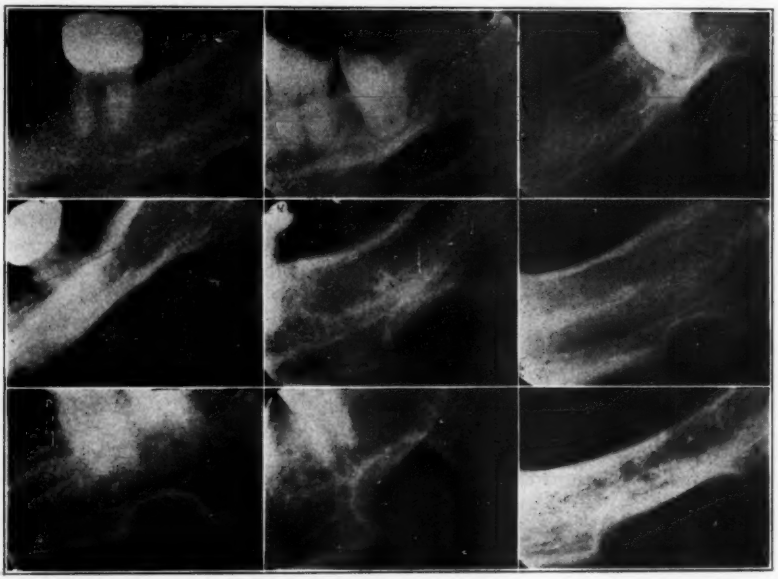

Fig. 1.—Nine bone cavities of varied size situated in posterior region of mandible; illustrating typical roentgenologic appearance of such cavities.

green-producing streptococci were isolated. Brunschwig states that these cysts are usually unilocular. The cavity may contain yellow or brownish fluid. Often, it is almost filled with loose granulation tissue, which is attached to a fibrous tissue lining. The granulation tissue is made up of immature fibrous tissue in which there are thin-walled blood vessels and regions of hemorrhage. There is an infiltration of lymphocytes, plasma cells, trauma was an etiologic factor, since there was a history of injury at the site of the cyst. Blum said the cystic cavity was a result of hemorrhage and extravasation into the bone, from trauma. However, in the series of bone cavities seen at the angle of the mandible, and reported here, there was no history of trauma. In all instances, the condition was symptomless and the patients were aware of the bone cavity only when

it was revealed by the roentgenogram.

Most congenital defects are accounted for on an embryologic basis. There are three categories of bone formed: cartilage bone, membrane bone and cartilage bone developed from the cartilages of the branchial arches. McMurrich says that bones in each of these categories are primarily quite distinct from one another, but, in the human skull, a considerable amount of fusion takes place, and elements in two or even all three categories may unite to form a single bone. In the mandible, the original branchial cartilage (Meckel's) becomes ensheathed by membrane bone and eventually disappears completely, so that the adult bone, although represented by a cartilage, is really a membrane bone.

In the third fetal month, accessory cartilages appear in the mandible in connection with primary membrane bone, the condylar, coronoid and two nuclei at the symphysis. A definite angular nucleus has not been observed, although, in some other mammals, a distinct angular cartilaginous nucleus exists. In the 95-mm. fetus, to quote Low:

> The condylar cartilage is wedge-shaped in appearance and passes downward through the ascending ramus, its pointed lower extremity passing forward into the body of the jaw and terminating so far forward as the level of the front of the base of the coronoid process. The cartilage is covered on both lateral aspects by perichondrium continuous with the periosteum. Under the microscope the cartilage towards its anterior part shows regressive changes, being destroyed by giant cells, and its place taken by marrow tissue and eventually bone. Posteriorly the cartilage expands to form the condyle—formed of hyaline cartilage covered with perichondrium. . . .
>
> In a foetus 230 mm. in length only traces of these cartilages remain, and they are now surrounded by bone. The cartilage in the coronoid process has practically disappeared, but the condylar cartilage still persists, although its anterior part is much broken up by large marrow spaces and deposits of bone. . . .
>
> From an examination of microscopic sections and naked-eye preparations of foetal lower jaw from this stage till full time one finds that the jaw rapidly becomes wholly converted into bone, Meckel's cartilage behind the canine tooth gradually atrophies, all trace of the coronoid cartilage disappears, while remains of the condylar cartilage persist until birth.

It is the condylar cartilage which may give some clue to the origin of the bone cavities under discussion. The pointed lower extremity of the condylar cartilage which passes forward into the body of the mandible is situated near and parallel to the inferior border of the mandible. From Low's description, it is noted that regressive changes in the cartilage toward its anterior part appear early, and, in the fetus 230 mm. in length, this anterior part is "much broken up by large marrow spaces and deposits of bone." It is possible that a cavity could result and persist from a failure of normal deposition of bone in the region formerly occupied by cartilage. Since the perichondrium of that part of the cartilage which is proximally from the

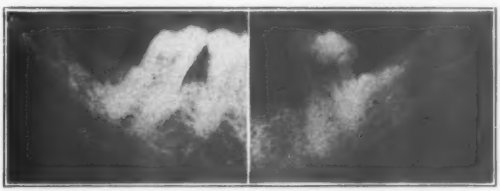

Fig. 2.—Bilateral cavities of mandible.

surface of the mandible is continuous with the periosteum, a failure to form bone from the periosteal side may account for the instances in which the cavity is not surrounded completely by bone, but has an opening on the inferior border of the mandible.

Records of physical examination of all the patients in whom the bony cavities occurred were available. A review of these records was made, in the belief that the information obtained from them might lead to some explanation for the occurrence of the cavities.

The results of the physical examination of nine patients were either essentially negative or of a minor nature. Among the remaining patients, there was the usual distribution of cardiovascular, gastro-intestinal and respiratory ailments or some form of rheumatism. There was no evidence of glandular disturbance except in a patient who was suffering from diabetes. Serologic reactions were negative in all patients examined.

Complete dental roentgenograms were made of all patients. Bone adjoining the bone cavities, as well as that in other regions of the jaw, was normal in appearance. In twenty-one cases, roentgenograms had been made of one or more bones other than the teeth and jaws. These roentgenograms included ten of the spine, three of the pelvis, ten of the extremities and four of the skull. Those of the skull and pelvis were negative, as were three of the spine and four of the extremities. All of those that were positive revealed changes associated with arthritis, with the exception of one in which a destructive change seen in the tibia was associated with osteomyelitis. There was no evidence of polycystic disease in any of the roentgenograms made.

COMMENT

The constancy of locale and the similarity of roentgenologic appearance suggest that this condition is a definite entity with probably a common etiology. Certain etiologic factors could be ruled out logically with the limited evidence available.

Because, in one instance, the condition was bilateral, one might suggest with reservations that the cavities are congenital. However, until an opportunity is presented to make a microscopic examination, the true nature and the cause of this condition are problematic.

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THE PLACE OF THE FIXED BRIDGE IN RESTORATIVE DENTISTRY

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FOR a considerable number of years, I have been a teacher of crown and bridge prosthesis at the University of Michigan. While my major interest and time have been devoted to teaching, I have also carried on a part-time practice. I mention this in passing, lest some make the criticism, so frequently made, that teachers, because they are surrounded and possibly steeped in academic traditions and conventions, fail to realize the practical and especially the economic phase of general practice. I say "general" practice, because mine has been such. There was a time years ago when I hoped to limit my practice to crown and bridge prosthesis. That was before the depression. To my knowledge, a specialty of crown and bridge prosthesis does not exist at the present time. I seriously doubt whether there are many communities in which a practitioner could limit his practice definitely to crown and bridge work, and continue to pay his rent. The reason for this is quite obvious to one who has followed the development of bridgework over the last two decades.

The modern fixed bridge is an integral part of operative dentistry. You may call it a fixed partial denture, if you will, but that does not alter the fact that it is more nearly a further development of the cast gold inlay than it is a phase of what we know as partial denture prosthesis. From the standpoint of function and of support of the appliance, it is often difficult to draw lines of demarcation which are valueless except for argument.

Read before the Section on Partial, Crown, Bridge and Full Mouth Reconstruction at the Seventy-Eighth Annual Midwinter Meeting of the Chicago Dental Society, February 26, 1942.

The modern fixed bridge is quite a different thing from the intricate and complicated restorations designed and constructed by the followers of Goslee, Chayes, Peeso and others. Whatever our opinion of those appliances may be, we must, from the historical standpoint, at least give them credit for developing some of the most ingenious mechanical procedures that dentistry has known. The acrimonious arguments that were prevalent in the profession twenty-five years ago in regard to the relative advantages of fixed and removable forms of bridgework no doubt aroused a good deal of interest in dental society meetings, but probably accomplished little else, since those who had paid money for a course in removable bridgework were determined to use it, and those who had not taken the course were unable to carry out the complicated restorations anyway.

There are still many in the profession who are inclined to continue these arguments. Frankly, I cannot feel that there is much to argue about. True enough, there is some overlapping of the fields of application of the two types, fixed and removable, but, in a large number of these cases, the economic factor is of sufficient importance to settle any argument. I feel that where its use in indicated, the removable bridge employing precision attachments affords about the finest possible type of restoration, but the number of dentists in this country who are adequately equipped, both by experience and by operative skill, to render this type of service is so small that, for the purpose of this discussion, consideration of the precision type of removable bridge will be left out.

In order to discuss the place of the modern fixed bridge in dental prosthesis with any degree of clarity, it might be well to define the terms used. By modern fixed bridge, I mean the type of restorative appliance that is supported entirely by the remaining natural teeth, being attached to them by means of some form of cast attachment. The principal objective, of course, in any replacement of prematurely lost teeth is the restoration of function with minimum damage or jeopardy to the remaining natural teeth or tissues of the mouth. I use the term "minimum" advisedly, as we may as well admit, both to ourselves and to our patients, that no restoration can be carried out without the possibility of some damage to the remaining natural teeth or tissues of the mouth. When I speak of restoration of function, I refer not to masticatory function alone, but to all functions performed by the natural organs, and for the sake of brevity and simplicity, I shall include appearance as a function of the natural organs.

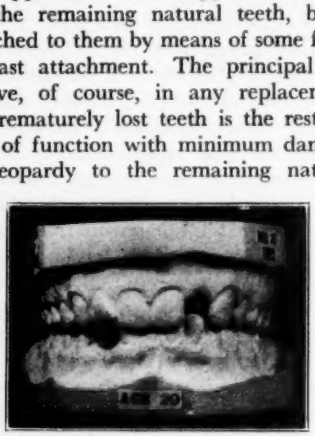


Fig. 1.—Typical indication for fixed bridges replacing maxillary lateral and mandibular cuspid.

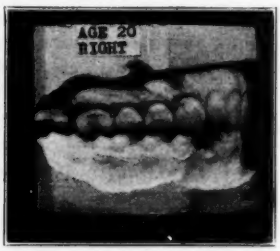


Fig. 2.—Cuspid replacement. This can be accomplished by the use of both first and second mandibular bicuspids.

From years of clinical observation, I am convinced that as a profession we are negligent in not impressing upon patients that damage to the entire dentition may result from extraction of a single tooth. All too frequently, patients are dismissed with either a statement or the implication that the edentulous space "won't show" and they "won't miss the tooth much anyway." In far too many cases, unless the patient demands some form of restoration, the dentist does not even consider what may be done. There are, of course, a large number of cases in which attempted restoration may cause greater damage than if the edentulous space is left entirely alone, and certainly no restoration should ever be attempted unless the dentist is convinced that the

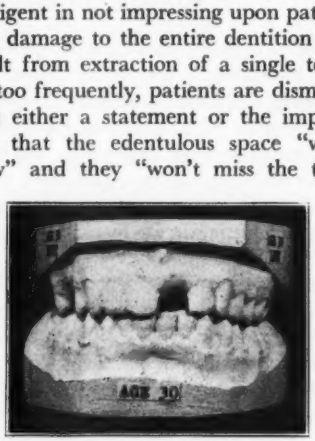


Fig. 3.—A case in which properly designed and well-constructed fixed bridge will provide better appearance, better function and greater comfort and convenience for patient.

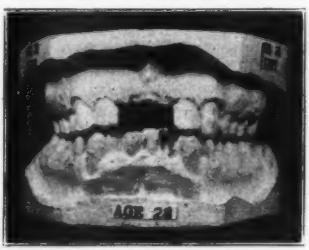


Fig. 4.—Type of case in which age of patient influences to large extent choice of method of restoration.

advantages of restoration will outweigh any possible damage to the remaining natural teeth or tissues. A decision in this regard requires careful study and diagnosis of the conditions present and also a knowledge of the various methods by which restoration may be accomplished. Far too many of us are "oversold" on a particular method of restoration, and, unless the case fits the method, we are prone to dismiss the patient with the idea that no restoration is practical. No one method of restoration can possibly be

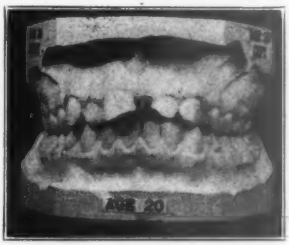


Fig. 5.—Case of left central incisor lost in accident which also devitalized left lateral and right central incisors.

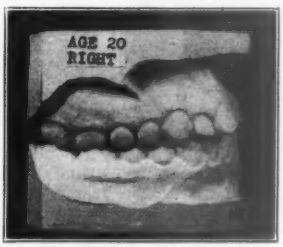


Fig. 6.—Difficulty encountered in attempting to use partial denture employing clasps.

universally applicable, and the practitioner who is conscientious in rendering the best possible service to his patients must be familiar with all the accepted methods of restoration, must recognize the indications for their use and must choose with fine discrimination and sound judgment that method which best meets the requirements of a particular case.

I shall not take your time with even a review of some of the controversies that have taken place in regard to methods of restoration and types of appliances. Today, we may say that, in general, two types of restoration are used where a number of teeth remain in either arch, the fixed bridge and the partial denture. In a comparatively few years, there has been such great improvement in design and construction of partial dentures that many of the disadvantages of this method prevalent a few years ago have been eliminated. This progress has widened the field of application of the partial denture and has had the effect of narrowing, at least to some extent, the field of the fixed bridge. I submit, however, that where its use is indicated, the fixed bridge possesses some marked ad-

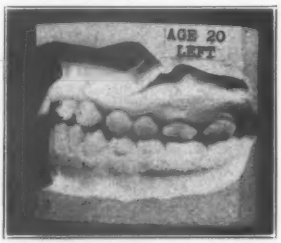


Fig. 7.—Difficulty encountered in attempting to use partial dentures employing clasps.

vantages over other forms of restorative appliances. These advantages are chiefly increased efficiency in mastication, better appearance in many cases and greater comfort and convenience for the patient.

In a comparison of the advantages with the possible damage to the remaining natural teeth, no general statement is of the least value. There are too many factors involved, and any decision in this regard can be made only after careful study and evaluation of the conditions presented. True enough, the fixed bridge requires the preparation of teeth to receive castings for attachment, while the partial denture employs clasps, which frequently minimize preparation of abutment teeth, but let us not forget that

even the best clasps may cause destruction of the teeth on which they bear.

I doubt whether any one will deny that efficiency in mastication is directly proportional to stability, and that virtually no removable appliance furnishes the same stability as does the properly designed, well-constructed fixed bridge. Nor do I believe that many will deny the additional comfort and convenience of a restorative appliance held in position in such a manner that it becomes an integral part of the dentition and does not have to be removed even for cleaning. These advantages are real, not merely fancied. The question may be raised as to why we do not use the fixed bridge in more cases than we do. Perhaps the best general answer to this question is the statement that the anatomic form of the teeth that are to serve as abutments, both crown and root form, the character of their support and their position in the arch frequently prevent the successful application of the fixed bridgework.

To attempt to describe accurately the definite field of the fixed bridge is extremely difficult because of the wide variation of conditions in the mouths of those who present themselves for restorative service, and space does not permit a thorough discussion of many of these conditions. There are a few, however, that are sufficiently important to be included here.

I have contended for years that the patient's age is one of the very important factors in the selection of a method of restoration. Realizing that no restoration is permanent, we must remember that if we are to render a conservative service, we must constantly keep in mind what the next step will be, if and when the immediate restoration fails. What may be radical treatment at one age level may be considered conservative treatment at another. The influence of age upon calcification makes a vast difference in what can be done in the preparation of vital abutments. While

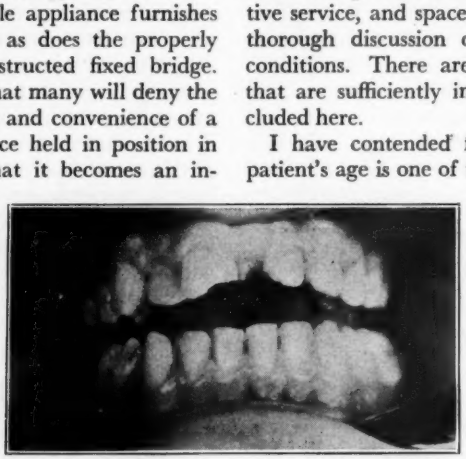


Fig. 8.—Actual photograph of mouth shown by cast in Figure 5.

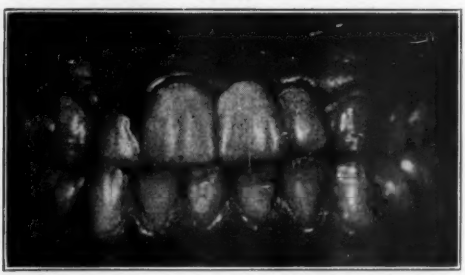


Fig. 9.—Restoration completed (compare Fig. 5) by use of acrylic crowns and pontic.

the degree of calcification should be carefully checked by x-ray diagnosis, the age factor is nevertheless important. Age is also likely to be an important factor in the patient's psychologic reaction to a restoration. It has been my experience that young patients are more intolerant of removable appliances, especially those employing palatal or lingual bars, than people in later adult life. Unless a removable appliance includes an anterior tooth, younger patients are not inclined to wear it enough to receive the benefit from it which they should receive.

Fig. 10.—Case that was difficult because of patient's age and movement of teeth that took place after extraction.

Fig. 11.—Opposite side of mouth shown in Figure 10; showing movement of teeth following extraction.

The susceptibility to caries found in many young patients is a definite contraindication for any restoration employing clasps.

Another very important factor in the selection of a method is the presence of caries or fillings of any kind in the teeth to be employed as abutments. Not only does this frequently denote the degree of calcification, but it may also denote that so much of the central body of dentin has been destroyed, either by caries or preparation for the filling, that adequate retention for a fixed bridge cannot be obtained.

In the time allowed here, it will perhaps be possible to accomplish more toward defining the place of the fixed bridge in restorative dentistry by a discussion of practical cases. A discussion of models must of necessity be incomplete, since models do not show all of the conditions present, but we shall have to assume, in the models shown, that the abutments are in a state of health and have not been so injured by caries or previous fillings that retention of attachments is impossible.

Figure 1 illustrates what I consider a typical indication for the fixed bridge,

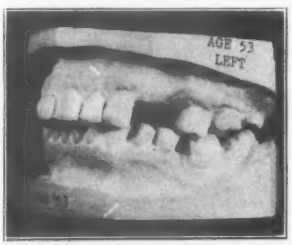


Fig. 12.—Left side of cast shown in Figure 13; a case in which bilateral partial denture may be used, but in which two fixed cases, if properly constructed, are likely to provide greater comfort and convenience for patient.

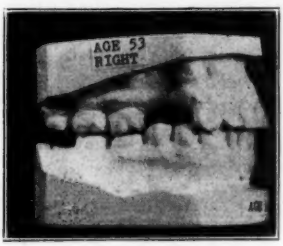
or rather for fixed bridges, as two restorations are necessary in this case. The restoration of the lateral incisor in those cases in which the cuspid is unusually bulky and long, and the incisor itself is not usually wide, may be accomplished by simply suspending a lateral facing from a suitable casting on the cuspid. This is about the only place in the mouth, however, where a simple suspension can be used successfully, and one must be sure that the cuspid root is of sufficient length and bulk to withstand the additional stresses, especially those which tend to rotate the root in its socket. In this case, the patient's age should indi-

cate sufficient calcification for preparation of a cuspid of this shape for retention of an attachment.

That restoration of a missing cuspid (Fig. 2.) is frequently difficult is especially true of mandibular cuspids owing to the fact that the mandibular lateral incisor is of so little value as an abutment, and it is difficult to prepare the crown of the first bicuspid without endangering the health of the pulp.

One method of restoring cuspids that I have found quite successful involves the use of the two bicuspids. That is, both first and second bicuspids carry three-quarter crowns, attached to one another by means of a definite dovetailed, non-rigid joint, and the cuspid facing is then suspended from the first bicuspid casting. If the crowns, and

Figure 3 illustrates another case in which I consider the fixed bridge to be the restoration of choice. Frequently, in restoring a central incisor, a central facing is simply suspended from a casting on the remaining central incisor. Occasionally, we even see them suspended from only the lateral incisor. In nearly all of these cases, the incisor from which the facing is suspended shows looseness after a comparatively short time. The reason is obvious. Neither the central nor the lateral incisor root can withstand for any length of time stresses that tend to rotate the root in its socket. Attaching a facing to a single incisor is in effect attaching a lever that places severe rotational strain upon the root. This rotational strain must be resisted to prevent loosening of the abutment.



A

B

Fig. 13.—A: Right side of case shown in Figure 12. B: Left side of case shown in Figures 14-15. A bilateral denture is indicated.

especially the dovetailed joint, are properly constructed, the second bicuspid as well as the first will be forced to assume a considerable amount of the load that may be applied to the cuspid.

A number of years ago, these cases were constructed with a rigid solder joint between the bicuspid crowns. While the majority of these restorations were successful, too large a percentage showed loosening of one of the castings after varying periods of wear. The use of the non-rigid joint has eliminated this difficulty almost entirely and, as far as I can determine, is fully as successful with regard to resistance to stress as the rigid solder union.

When conditions are favorable, that is, when the abutment root is sufficiently long and well supported, a simple stress-breaker, consisting of a pin resting in a definite slot in an inlay on the lingual surface of the lateral incisor, will prevent rotation of the abutment root. If there is any question in regard to the ability of the remaining central root to withstand the additional stresses, the supplied central incisor should be rigidly attached to both central and lateral incisors.

In the restoration of both central incisors, the age factor is especially important. The maxillary lateral incisor, in the great majority of cases, is not a favor-

able abutment. Frequently, the size and shape of the lateral root is such that it cannot withstand heavy additional stress for any great length of time. In addition to the fact that the root is none too favorable as an abutment, the crown of the lateral incisor is often so small or of such shape that it is virtually impossible to make preparations for attachments that will not jeopardize the pulp. In patients beyond middle life, if the cuspids are favorable as abutments, we are justified in the extraction of the lateral incisors, and the restoration of all four incisors supported by the cuspids. In younger patients, conservation of the cuspids is of paramount importance. As I stated earlier, we must constantly bear in mind that no restoration is permanent, and we should have pretty definitely in mind a plan for further restoration if the immediate restoration fails. If for these younger patients, for instance the case shown in Figure 4, at age 28, we can force the lateral incisors to carry a prosthesis for ten years, or even less, we have postponed by that length of time the use of the cuspid as abutments, and we have also postponed by years the time when a much more extensive restoration will be necessary. While I hesitate to interject the statement at this time for fear of being misunderstood, I am convinced that, in younger patients, we are often justified in extirpating the pulps of lateral incisors, if retention cannot be obtained without jeopardizing their health, and if the x-ray diagnosis shows roots that will lend themselves to root surgery procedures and filling. It may well be argued that the use of a partial denture would eliminate the necessity of pulp extirpation in these cases, and the point is well taken. Retention of a partial denture, however, would necessitate clasping some posterior teeth, and we must be sure that the possibility of damage to posterior teeth is not greater than the damage to two lateral incisors that may be replaced later in life.

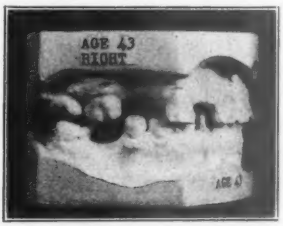


Fig. 14.—Right side of case shown in Figures 13, B and 15.

Fig. 15.—Palatal view of case shown in Figures 13, B and 14. The unusually large torus is a contraindication for the use of a partial denture.

Fig. 16.—Left side of case in which fixed bridge is contraindicated because of long span (cuspid to second molar) and inadequate support of second molar.

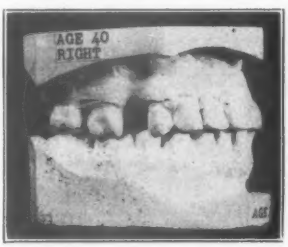


Fig. 17.—Right side of case shown in Figure 16.

In the case shown in Figure 5, the left central incisor was lost in an accident that fractured both the left lateral and the right central incisors to such an extent that pulp death occurred subsequently in both. While the photographs of the cast do not show the condition clearly, it would have been almost impossible, because of the high attachment of the tissues on the lingual surfaces of the cuspids, to prepare them for castings that would support a cuspid-to-cuspid bridge.

Examination also shows that clasp retention anywhere in the posterior part of the mouth for a partial denture would have been almost impossible, without radical preparation on sound teeth. (Figs. 6 and 7.)

After treatment and root canal filling, an acrylic case was constructed, with a metal frame with posts in both canals. (Fig. 8.)

While it is not expected that the restoration illustrated in Figure 9 will last a lifetime, it should give service at least until the tissue condition about, and the calcification within, the cuspids are more favorable to their use as abutments.

The early loss of first molars (Fig. 10) presents a difficult problem in restoration. The rapid movement of teeth following these early extractions, with the resultant damage to the entire dentition, is a condition that we all know too well. What can be done to prevent this damage when the teeth must be extracted is a matter that requires careful study and sound judgment, to prevent even greater damage in the attempt at restoration.

It will be noted that in the case illustrated in Figure 11 both mandibular second molars show the mesial and lingual inclination so characteristic in these cases of early extraction of the first molars. This position, in addition to the lack of calcification at this age, makes the preparation for attachments for fixed bridges a hazardous operation. On the other hand, in a large number of these cases, susceptibility to caries is a contraindication for the use of clasps. A wise decision in regard to the method of restoration can be made only after careful evaluation of the factors in the individual cases. The position, degree of calcification and support of the abutments, the susceptibility to caries and the patient's psychologic reaction both to the restoration and to mouth hygiene, as well as periodic mouth examination, are factors that must be carefully considered.

Susceptibility to caries is usually not so important a factor later in life, and some may maintain that the case shown in Figure 12 calls for a bilateral partial denture, and no doubt a satisfactory partial denture could be constructed. The difficulty in clasping cuspids, from the standpoint both of retention and of avoiding display of metal and the nuisance of a palatal bar, would certainly contraindicate a partial denture.

Clinical experience over a number of years has shown that the maxillary cuspid to first molar fixed bridge, when properly constructed, is one of the most successful bridges. (Fig. 13, A.) From the standpoint of function, comfort and convenience, two fixed bridges would be preferable to a partial bridge.

The case in Figure 13, B is similar to the one in Figure 13, A, except for the missing right lateral incisor and mandibular first molar.

Again, it may be argued that in the case shown in Figure 14, a bilateral partial denture for the upper jaw would offer the easiest solution for the problem presented. The easiest solution, however, may not be the best, and a view of the palate may change one's opinion in regard to the method of restoration.

While the missing lateral incisor complicated the case in Figure 15 to some extent, the patient has been wearing two fixed bridges in the upper jaw and, I am sure, has had greater comfort than would have been possible with a partial denture.

While the bridge extending from the maxillary cuspid to the first molar (Fig. 16) is one of the most successful fixed bridges, we have learned to beware of the cuspid to second molar fixed bridge. In a large number of cases, the roots of the maxillary second molar are either partially or completely coalesced, and, under these conditions, the tooth is a poor abutment for such a long-span fixed bridge. It is the lateral stresses that tend to loosen these roots, and the effective resistance to these lateral stresses which can be gained only by crossing the arch with a rigid palatal bar and forcing the teeth on the right side to assume some of the load expressed on the left. This, of course, cannot be done by a fixed bridge. Therefore, restoration is in this case definitely in the field of the partial denture.

In the case shown in Figure 17, the missing right bicuspid offers an excellent opportunity for attachment of a palatal bar.

It is seldom indeed that two cases calling for restoration of prematurely missing teeth exhibit identical conditions. There is such a wide variation in individual cases that, from the standpoint of treatment, there can be no definite rules, no empiric formulae. Careful evaluation of the conditions present, combined with discrimination and good judgment, is the only formula of any value in this type of service.

METHODS OF PROCEDURE IN A DIAGNOSTIC SERVICE TO THE EDENTULOUS PATIENT

By M. M. De Van, D.D.S., Philadelphia, Pa.

IT is generally granted that no phase of the practice of dentistry is more uncertain in outcome than complete denture service. The object of this presentation is to supply information calculated to minimize this uncertainty by (1) analyzing pertinent facts regarding full dentures; (2) eliminating unfavorable reactions to complete dentures, and (3) reducing dissension, material costs and loss in time and temper.

The following topics will be discussed:

1. Presentation to the patient of the need for a diagnostic study.
2. Steps essential in the diagnosis.
3. Evaluation of the information gathered.
4. Prescription based on the diagnostic data.
5. Report to the patient of the information gathered.
6. Periodic check-up of the denture case.

Read at the Greater New York Dental Meeting, December 3, 1941.

Jour. A.D.A., Vol. 29, November 1, 1942

PRESENTATION TO THE PATIENT OF THE NEED FOR A DIAGNOSTIC STUDY

The dentist should meet the mind of the patient before he meets the mouth of the patient. The prospective denture patient should be given the opportunity to tell the dentist what he wants before he is told by the dentist what he needs. For denture ventures to be successful, minds as well as mouths must be individually understood and treated. After the patient has had his say, a superficial ex-

amination of the mouth condition is made. It is fair to state frankly what we have observed and what we think the patient's problems are. The patient should then be told that he has too much at stake in health, comfort and appearance for any one to prescribe replacements on the basis of a casual and limited study. Both our own interests and those of the patient will be better served if a superficial judgment is either confirmed or modified by information gathered during a detailed diagnostic study. Too much cannot be known about the patient, physically or psychologically. The information should be obtained, appraised and evaluated prior to impression taking. The steps in diagnosis are indicated and the fee for the service is quoted in advance. Without pressure, the patient is given an opportunity either to accept or to reject it.

It has been my experience that if a patient's consent to a diagnostic study cannot be obtained, there is lacking, to start with, the understanding and mutual trust essential to an ultimate satisfactory patient-prosthetist relationship; for no other phase of restorative dentistry demands the degree of confidence required

Fig. 1.—Diagnostic upper impression. This should contain overextensions of heel and flange. The white modeling compound used is more pleasing to the eye and possesses sufficient strength for snap impressions.

Fig. 2.—Lower diagnostic impression. This should include the retromolar pad and flange extensions beyond the external oblique ridge buccally and below the mylohyoid ridge lingually.

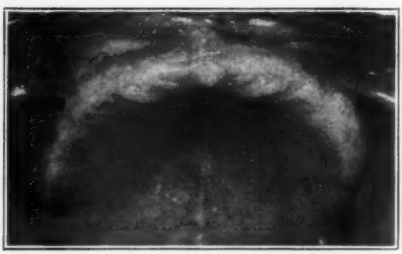


Fig. 3.—Maxillary base. This is studied for normalcy of color and contour. The case portrayed possesses satisfactory length of ridge. Its width, when compared with that of the mandibular base, is only fair. The case history revealed failure to insert immediate dentures after extraction. The prolonged non-dentulous period, when the patient was without natural and artificial teeth, is probably responsible for the atrophy of the external cortical plate. The color of the so-called ridge is subnormal as compared with the color in the lips and cheeks.

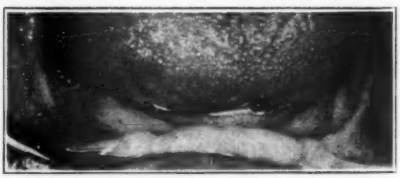


Fig. 4.—Mandibular base showing advanced resorption in molar-premolar regions. The case history revealed failure to replace the natural molars and premolars with a partial denture. The prominent anterior ridge is advantageous as the anterior stress component meets with great resistance because of its presence.

in full dentures—confidence of the dentist in his ability to make dentures, as well as the confidence of the patient in the dentist's ability to do so. Otherwise, the unavoidable functional limitations of these dental crutches are apt to be ascribed to lack of skill and craftsmanship.

There appears to be no valid reason why a painstaking diagnostic service to the edentulous patient should not be remunerative to the dentist. The fact that it is seldom profitable is due primarily to the public's lack of appreciation of the importance of such a service. Until persons are educated to its value, it will usually be necessary to give a discount on the cost of rendering the suggested diagnosis. However, since adopting the plan of making the preliminary study a requisite to denture construction, we have succeeded in reducing dissension to a minimum. Prior to that, discord and dissatisfaction were kept at a tolerable degree only through costly "make-overs" and an occasional refund. Perfection is not claimed for the procedure: it has its drawbacks. Some patients will be lost to start with. This loss, however, will be balanced by retaining more patients in the end; for, in the long run, the well-established practice will depend less and less on the acquisition of new patients and more and more on the retention of those already in the practice. The foregoing is based on the concept that as long as the patient lives, he will at intervals require some service, perhaps diagnostic, perhaps restorative.

Our service to a new patient is threefold: (1) to find out what his condition is; (2) to decide what can be done about it, if anything, and (3) to carry out the treatment planned. The steps in diagnosis are concerned with the first and second phases of this service.

STEPS IN THE DIAGNOSIS

The diagnostic study of the edentulous patient may mean little or much, depending on the discrimination and discernment of the dentist. At best, it will constitute the patient's medical and dental chart, plus a workable blueprint of the foundational circumstances and the proposed superstructure.

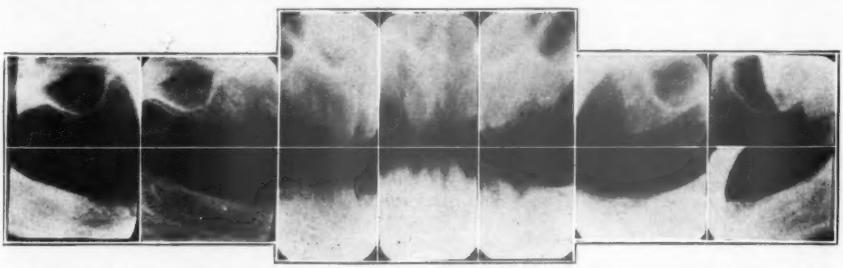


Fig. 5.—Satisfactory degree of condensation and solidification of maxillary base and of molar-premolar areas of lower jaw. It is reasonable to conclude that well-fitted dentures will remain satisfactory under such circumstances. In contrast, there is porosity with lack of consolidation of the alveolar bone in the anterior region of the mandible. Further resorption is to be expected and the patient should be informed of the probable necessity of refitting in the future.

The sequence of steps recommended is as follows:

1. Roentgenograms of the edentulous ridges.
2. Snap impressions and pouring of stone casts.
3. Transillumination of ridges and sinuses.
4. Inspection of throat, tongue, lips and cheeks.
5. Record of the case history.
6. Construction of diagnostic bite-

plates and taking of the diagnostic bite.

7. Determination of the condylar inclination at the vertical dimension of the diagnostic bite.

In a well-organized and well-staffed office, the taking, developing and mounting of the roentgenograms may be relegated to lay assistants, their examination and interpretation being reserved for the dentist.

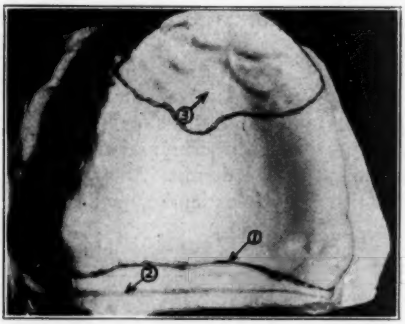


Fig. 6.—Maxillary diagnostic cast depicting (1) bite-plate outline, (2) impression tray outline and (3) relief tray area. The diagnostic bite-plate outline is short at the heels, extending to the junction of the movable tissue and not beyond.

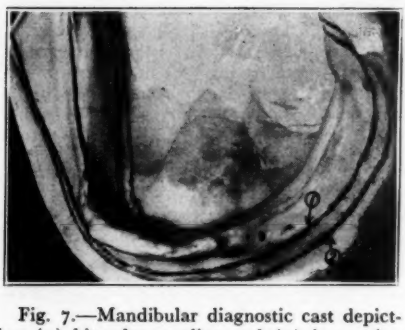


Fig. 7.—Mandibular diagnostic cast depicting (1) bite-plate outline and (2) impression tray outline. The diagnostic bite-plate outline should not be so extensive as the ultimate denture outline.

Oversized trays (small enough to comfortably pass the lubricated corners of the mouth) are filled with softened modeling compound and carried into the mouth. The resultant impression should include overextensions of heel and flange. In a suitably built dark room, transillumination can be of great assistance in the detection of soft tissue congestion about the ridges and in the maxillary sinuses.

With the aid of a daylight mouth bulb, the dark room presents an opportunity to inspect the form and color of the throat, tongue, lips and cheeks. The case history

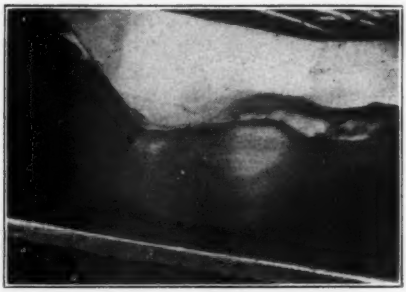


Fig. 8.—Upper part of maxillary diagnostic bite-plate, showing level and inclination of base or ridge plane. The flat piece of aluminum contacting the shellac base-plate at any three points determines the ridge plane.

Fig. 9.—Completed diagnostic upper bite-plate ready for contouring in mouth.

should be taken in the consulting room. Pertinent questions will yield information relative to the (1) head, (2) hearing, (3) temporomandibular joint, (4) throat condition, (5) digestion and (6) elimination. At this time, the denture history of the case is secured. How long has the pa-

tient been edentulous? How many sets of dentures has he had and why? Did he wear partial prior to complete dentures? We classify the patient mentally and emotionally, using House's system, and recording whether he is philosophic, exacting, hysterical or indifferent.

The diagnostic bite-plates are constructed of shellac base-plate wax and waxes that differ in color. A light pink wax forms that portion of the bite above the ridge plane, while a tooth-tinted

Fig. 10.—Lower part of mandibular diagnostic bite-plate showing level and inclination of base-ridge plane. The retromolar pad is ignored in determining the ridge plane.

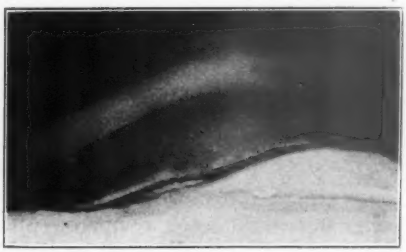


Fig. 11.—Completed lower bite-plate ready for contouring in mouth. The juncture of the pink and tooth tinted wax indicates the level and inclination of the ridge plane.

wax forms the rest of the bite-rim. With the aid of this bicolored wax bite-rim, it is possible, while securing the vertical dimension, to note the position and inclination of the occlusal plane in its relationship to the underlying ridge plane. Whenever possible, the occlusal plane should be parallel to its respective ridge plane. The total vertical opening should permit clearance especially at the end of sibilant consonants. These bite-plates are adjusted and trimmed to a pleasing fullness and length. The distance between the nose and chin is measured with a bite gage and recorded on the diagnostic chart. If the patient is wearing dentures, measurements are also taken with old dentures in the mouth. A provisional

Fig. 12.—Upper bite-plate trimmed to pleasing fullness and length. If the appearance permits, the bite-rim plane (stress plane) should be parallel to the ridge plane. In successive steps, the lower bite-plate is cut down anteriorly and the softened posterior rims are contoured to give the desired working bite.

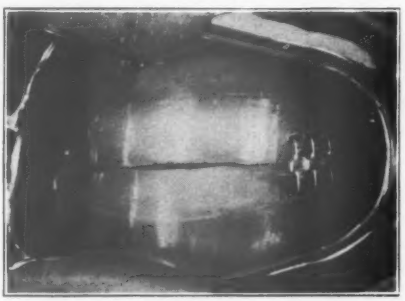


Fig. 13.—Completed diagnostic bite-plates sealed with staples. The use of bicolored wax bite-rims enables the operator, while taking the bite, to visualize the relationship between the ridge and the bite-rim planes. The use of a tooth-tinted wax in forming the lower part of the bite-rim is recommended as the desired contour is more easily attained where color harmony exists.

centric position is accepted and, with Hotchkiss staples, the bite-plates are

sealed together. A well-polished adjustable articulator is used in the mounting of the case.

EVALUATION OF THE DIAGNOSTIC DATA

After the diagnostic information has been obtained, sufficient time and effort should be spent in its evaluation. The roentgenograms are enlarged and projected for better interpretation. First, the character of the trabecular structure, whether close meshed or rarefied, is noted. The close-meshed type is able to withstand tensile and shearing forces with minimum disintegration. The border of the so-called ridge is studied for outline form, as to whether smooth or jagged. A smooth gradient ridge will require fewer denture adjustments and refittings.

Fig. 14.—Relationship of upper and lower casts at level of most desirable vertical height. There is an extreme degree of separation in the molar region. Horizontally, the casts reveal a disparity in size necessitating a crossbite set-up. The foregoing information cannot be accurately obtained by merely looking into an edentulous mouth.

Unusual areas of plus or minus density are looked for, since they may indicate trouble, as from unerupted teeth, root fragments, residual infection, cystic areas and condensing osteitis. If the primary purpose of tooth removal is the eradication of focal infection, these abnormal areas under dentures should be investigated.

The thickness of the mucoperiosteum covering the ridge is noted and recorded on the cast. The thicker the mucoperiosteum, the less its resistance to horizontal forces. A thick mucosa makes the problem of retention simple, the problem of stability difficult.

The size of the maxillary and mandibular casts is noted. The smaller the casts, the more difficult the problem of stabilization. The greater the disparity in size between the upper and the lower, the harder the task of stabilizing the dentures. Low muscle attachments also interfere with stability since flanges can not be carried high enough to harness the more or less vertically inclined flanges. The surgical removal of alveolar bone is usually inadvisable. However, the judicious cutting away, by means of a radio knife, of excessive mucosal tissue in the tuberosity region and elsewhere may be advantageous. Likewise, the severance surgically of low muscle attachments may prove helpful. As a consequence, the proposed dentures will have a more suitable flange form. If transillumination shows non-translucent and cloudy maxillary or frontal sinuses, head pains caused by this condition may be erroneously ascribed to the presence of an upper denture. Likewise, non-translucent ridge areas may denote congestion not discoverable in roentgenograms.

The color as well as the contour of the so-called ridges should be noted. Ridge tone should be compared with cheek, tongue, lip and throat color. If there is a general correspondence of color, local irritants are absent. If the mucosa covering the ridge is plus or minus the color value found in the rest of the oral cavity, we should be on the lookout for anemic or hyperemic agents.

The ultimate foundation of the proposed dentures is the nervous and circulatory systems; hence, the importance of securing a brief medical history. A person physically unstable is apt to find dentures functionally so. A badly coated tongue, a highly inflamed mucosa, a thin and blotchy facial skin are signs of dif-

ficulties to come in a denture contract. An irritated, inflamed throat with frequent coughing may call for special postdam treatment.

Likewise, a patient above or below the average emotional level makes a poor denture patient. A countenance that appears tense and unhappy, with nerves that are in rebellion, may predict a trying case. In such persons, the maintenance of a friendly relationship may not only demand of us a greater expenditure of time, energy and materials, but may also tax our patience and self-control.

The only information to be derived from unmounted casts is size and form. Their positional relationship can be observed only when they are placed in diagnostic bites and mounted on an articulator. The problem of stabilizing the dentures will depend on the relative

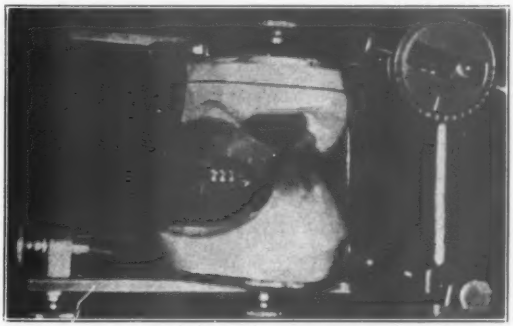


Fig. 15.—Protrusive relationship revealing a minus condylar inclination. This minus registration is undoubtedly due to tissue displacement and discrepancies in technic. It is a favorable diagnostic sign, as a steep condylar path at the vertical level of the diagnostic bite may be indicative of (1) an insufficient vertical dimension and (2) a retrusive centric relationship. The protrusive bite is easily secured by placing a mound of soft beeswax in the molar region and instructing the patient to protrude jaw in closing. Jaw pressure should cease just when the anterior bite-blocks approach contact. The split case technic as advanced by Monson is employed in determining the condylar indication.

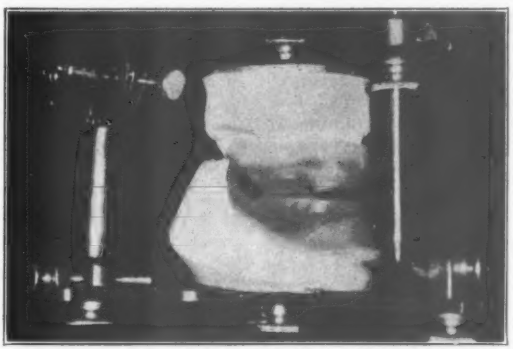


Fig. 16.—Base-plate wax patterns in position. They are subsequently removed and reproduced in vulcanite or acrylic. The diagnostic bites are useful in constructing vulcanite "impression-bite" trays.

positions of the articulated casts. The greater the vertical separation, the greater the problem. A horizontal disparity of the ridges is also an unfavorable sign. The diagnostic bite-plates afford an opportunity for observing ridge relationship at the level of the most desirable vertical height. It is well known that objects appear differently in themselves and in their relationship to one another, the appearance depending on how the line of one's vision falls on the scene. For example, we know little of the absolute size of the natural teeth from observing them at conversational distances. All we know is their size relative to the size of the face and to the line of vision. Likewise, we know little of ridge relationship from merely looking into an edentulous mouth. I have been impressed to observe what a different picture the articulated casts present when viewed in one's hand.

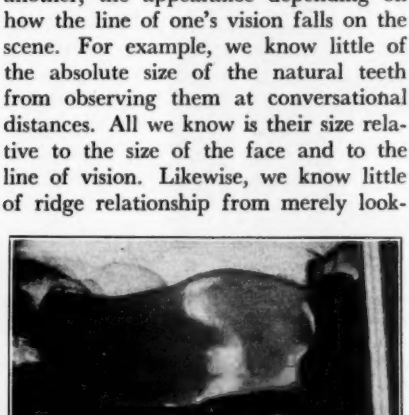


Fig. 17.—Close-up of vulcanite impression-bite tray. The contact is limited to the first molar-second premolar region. The subsequent constructional impressions are under functional stress applied only in molar-premolar areas.

PRESCRIPTION

Only when we know what the condition is and have reflected upon it are we in a position to decide what can be done about it. Our objective in prescribing for the patient should be his long-run needs modified by his short-run desires. The patient's fundamental need is the continued preservation of what remains of his chewing apparatus rather than the meticulous restoration of what is missing, since what is lost is in a sense irretrievably lost, and the continued conservation of the edentulous ridge will call for certain changes of natural tooth form and position. Objections on the part of the patient to such modifications should be contingent on his assuming responsibility for subsequent loss of denture stability. Let us prescribe what we know to be stable and durable dentures, altering our plans where we must because of an existing attitude.

The prescription should cover the denture needs for a period of at least two years. Under certain circumstances, we feel that the first set of dentures are in the nature of a treatment, the so-called final dentures to be made after the supporting base has settled and solidified sufficiently. The treatment dentures can then serve as a spare set.

There are conditions that make inadvisable the incorporation in the initial set of dentures of the optimum vertical opening. The most important is the degree of muscle tone. It has been my observation that the patient who has lost the teeth because they became loose and pyorrhetic possesses a low muscle tone. High muscle tone is usually the lot of those who have lost their teeth through apical infection or caries or for constructional convenience. A reliable index to the degree of muscle tone can be had by placing the index finger under the corner of the mouth and snapping it as one would a violin string. High muscle tone is usually accompanied by low interocclusal clearance.

It is both unfair and unwise to base a prescription on what we think the patient can afford to pay. Persons differ in self consciousness, and each is entitled to know what the ideal plan involves. My records reveal many cases wherein persons of low income coupled with a high esthetic sense have accepted the ideal plan; whereas, quite recently, a

patient with an exceedingly high income, but with little sense of the value of mouth health and appearance, rejected my recommendations.

It is advised that the following program be carried out without compromise. Base plan one on what is known to be the patient's needs, forgetting for the time being the cost involved; then work out compromise plans if cost is a consideration, placing the responsibility for the compromise where it belongs—on the patient's unwillingness or inability to pay.

REPORT TO THE PATIENT

The diagnostic information is not only useful in prescribing for the condition, but is also helpful in presenting recommendations. The patient is entitled to evidence of your study, such as articulated casts, diagnostic trial plates, projected roentgenograms and diagnostic chart. We should visualize their conditions by constant reference to casts, bites, x-ray pictures and charts; picture for them the scope, type and number of replacements planned; permit interrogation and answer all questions with candor and conviction. We may leave the task of arranging the series of appointments, the period of service and the method of payment to a secretary.

PERIODIC CHECK-UP

I am encountering less and less resistance to the suggestion that the edentulous patient return at stated intervals for a check-up. A fee is quoted in advance for this service, which includes an examination covering the occlusion, the degree of retention, the color tone of the mucosal tissues, the lip and nose contour and the relation of the condyles to the external auditory canals. It is also advisable to roentgenograph the alveolar support occasionally and compare the film with previous roentgenograms. Our comparative observations should be focused on the density and smoothness of the alveolar support. The denture should be examined for cleanliness and, if need be, the patient should be further instructed in their proper care. Periodically, they should be repolished in the laboratory.

I must confess that, in the beginning, I was not enthusiastic about the idea that complete denture patients should be seen periodically. However, I now support the plan, and for these reasons:

1. It gives the dentist the opportunity of observing his denture successes again and again, helping to maintain his confidence in his ability to make satisfactory dentures. This enables him, without loss of assurance and self-respect, to meet and deal with the inevitable prosthetic failures. We are inclined to dismiss our successes too quickly and be too long distressed by our failures. The patient whose denture is a failure will not return for periodic check-up; only those wearing dentures successfully may. Recently, I checked a case five years old, and I was amazed to note the extent of the vertical build-up of the dentures. On inferior ridges, unfavorably related, such a bite opening appeared risky. However, there it was, a complete success after five years. The effect of this check-up was the employment, in a current case, of a vertical dimension that I was hesitant to utilize. When I use the term "complete success," I have in mind not merely the patient's satisfaction with the dentures, which may or may not be justified, but rather the clinical condition observed: ridges with good tissue tone; occlusion normal vertically and horizontally; a degree of stability that kept the dentures apparently immobile when the patient brought the mandible forward with the teeth in occlusion; a pleasing, expressive lip contour; an absence of strain and tell-tale signs about the mouth now that the natural teeth are shed.

2. The periodic check-up provides an

opportunity for the dentist to evaluate, in the light of time, the various materials and technics employed. For example, my enthusiasm for the vinyl resins that have been so generally condemned is based on my observance of vinyl dentures in service, some for a period of ten years. Furthermore, periodic examinations more than anything else caused me to abandon the concept that attempts to secure bilateral balance with cusp inclines are conducive to bone preservation. I recently saw such a case constructed by me fifteen years ago. As far as the patient was concerned, the dentures were entirely satisfactory. Clinically, this was the picture: The mucosa appeared considerably inflamed in spite of the fact that there still appeared to be bilateral balance. Retention was fair, stability poor; that is, the upper denture under pressure appeared to move horizontally 3 mm. There was evidence that the underlying bone, no doubt owing to a constant state of mucosal torque, had disintegrated appreciably. However, the mucosa still contacted the denture, sufficient retention resulting. When a piece of resistive wax was placed between the teeth, the upper denture skidded considerably. Upon interrogation, it was learned that resistive foods had gradually been eliminated from the diet. The satisfactory condition of the denture was due, no doubt, to a diet of soft foods.

3. Through periodic visits, the dentist is given the opportunity of telling the patient whether he is still pleased with the dentures, or whether he feels that his efforts today would result in more harmonious and stable dentures owing to improvements in materials and procedures. If, in our judgment, the appearance and denture security can be enhanced, it is better that this information come from us than from another practitioner. Patients today are very apt to be interested in improvement. Only a few will question the suggestion that a denture constructed five years ago may in some way be serviced to advantage.

4. The periodic visit provides the occasion for ascertaining the matured reaction of the patient to our services. We know from dissatisfied persons who come to us from other offices that patients are not necessarily pleased when they no longer report for adjustments. It is well to inform the patient prior to the final adjustment that his failure to report for periodic examination will be interpreted as a loss of confidence in the practice. Of course, failure to return is his privilege. However, in all fairness, we cannot be held responsible for the case unless we are given the opportunity of seeing periodically the reaction time has decreed to our actions in behalf of the patient.

Spruce Medical Building.

THE EARLY DEVELOPMENT OF THE HUMAN PREMAXILLA

By Samuel W. Chase, Ph.D., Cleveland, Ohio

THE adult human maxilla is usually described as a single bone separated from its mate by the intermaxillary suture. Developmentally, however, it is derived from at least two components, the maxilla proper, forming in the region of the canine and molar teeth, and the premaxilla, arising in the incisal region.

In most mammals other than man, these two bones remain more or less distinctly separated by sutures throughout life. In man, they become indistinguishably fused in some of their parts early in development, so that, in the adult, the facial aspect at least appears both macroscopically and microscopically as a continuous bony mass. An occasional adult skull and all skulls at birth show an incisive suture between the premaxillary and maxillary components, particularly in the palatine process. The incisive suture ordinarily runs from the septum between the lateral incisor and the canine arcuately posteriad, then mesiad to the incisive foramen.

In many mammals, the premaxilla bears a long nasal process, which anteriorly forms the lateral boundary of the piriform aperture and articulates medially with part of the lateral margin of the nasal bone. Laterally, it articulates chiefly, if not entirely, with the maxilla. The frontal process of the maxilla meets that posterior part of the lateral aspect of the nasal bone which is not involved in the premaxillary-nasal suture, and articulates also with the frontal and lachrymal bones.

These two processes, the nasal process of the premaxilla and the frontal process of the maxilla, are fused in adult man to form the single frontal process. At birth, and occasionally in the adult, the internal aspect of the frontal process shows some remnant of the line of fusion, but most of the frontal process, as well as the body of the maxilla, normally shows no trace of the fusion.

Because phylogenetically and ontogenetically the human maxilla arises from these two components, there has been much interest in the development of the anterior portion of the upper jaw. Much of this interest is based on a desire to explain the variable relations of bones and teeth to maxillary clefts. Also, there has been much controversy concerning the number of centers of ossification involved and their time of appearance, sutural relations and contributions to the bony structures of the anterior jaw and nasal region.

This paper represents a search for information which may help to settle certain of the long-standing controversies regarding the human premaxilla and its relation to the maxilla. Chiefly, the early stages of development, up to a length of 40 mm., representing embryos of the eighth to the tenth week, will be treated here.

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HISTORICAL DATA

Concerning the number of centers of ossification, a review of the published papers of past investigators leads to confusion. However, two major theories can

be distinguished. These are usually designated by the names of their early proponents, Kölliker and Albrecht.

Kölliker believed that all parts of the premaxilla derived from a single center of ossification on each side. Among the supporters of his view are Schwink, Mall, Bruni, Inouye, Felber and Vallois.

Albrecht, whose theory was really antedated by that of Leuckhart, contended that the premaxilla arises from two centers of ossification on each side, forming a medial portion, which he named endognathion, and a lateral part, which he called mesognathion. Among others, Biondi, Herbst and Federspiel supported him.

Later, Jarmer asserted that three centers are involved: one forming the body, one the palatine process and the third, arising later and called by him the stenonian process, helping to form the anterior nasal spine, nasal crest and part of the bone of the nasopalatine canal. Peter accepted Jarmer's findings.

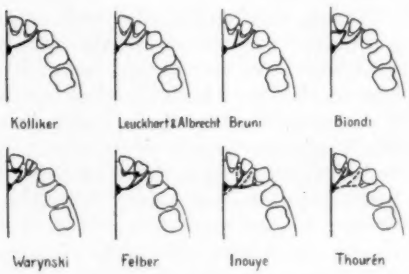

Fig. 1.—Location of sutures in premaxillary region according to different investigators. Usual position, solid lines; variant position, broken lines.

Besides these beliefs that there were one, two or three centers on each side, there are variant hypotheses, which complicate the situation. For example, Callender early asserted that the premaxilla has no center of its own, but arises by mesial extension of the body of the maxilla; and Fawcett, while failing to confirm Jarmer's views regarding a separate center for the palatine process, recognized a paraseptal or prevomerine center, which arises on the medial side of each paraseptal cartilage and corresponds to Jarmer's stenonian process, also with the much earlier described subvomerine center of Rambaud and Renault.

Schwink believed that there is usually only one center on each side, but that occasionally a separately ossifying center for the palatine process is found.

With regard to the time of first appearance of bone, there is also considerable divergence of opinion. Part of the confusion in this respect arises from the failure of many authors to state whether their designation of age of embryos is expressed as menstrual age or as ovulation age. Since the sixth week of ovulation age corresponds to about the eighth week of menstrual age, it is possible that a discrepancy of two weeks may be involved. Again, there is much individual variation in the length attained by embryos of a given age. Finally, as Patten and Philpott have shown, the length of individual embryos varies according to the fluid in which they are immersed when they are measured. For example, an embryo measured in 10 per cent formol is about 18 per cent longer than the same embryo measured in 95 per cent alcohol.

The claim for the earliest appearance of bone on a basis of age was that of Fawcett (1911), who said that the premaxilla begins ossification in the sixth week. Fawcett gave the length of his embryo as 17 mm., which, according to Streeter's data, based on menstrual age, is attained during the eighth week of development. Hence, Fawcett, like Felber, who gave the end of the sixth week as the time of appearance of the premaxillary center, was probably using ovulation age as a criterion.

The earliest appearance, based on length of embryo, was reported by Mall, who described both premaxillary and

maxillary centers in an embryo of 16 mm.

The latest appearance of bone, on the basis of length, was reported by Vallois, who gave 19.4 to 25 mm. as the range of length of embryos showing the beginning of the premaxilla. Vallois stated that the age of embryos in that range is the end of the second month.

The problem of the number and location of sutures between premaxilla and maxilla or between parts of the premaxilla itself has been beclouded by an extreme diversity of opinion. The controversial aspects have been so often reviewed in the past that only a brief summary will be presented here. For good reviews, the reader is referred to the papers of Vallois and Thourén.

Besides the incisive suture, which passes between the premaxilla and the maxilla, other sutures and pseudosutures have been described in such variety and complexity that scarcely a possible combination or permutation of arrangement and interrelation has been neglected. Some idea of the possibilities seriously considered by different investigators for palatine and alveolar processes alone is given by the schematic tabulation shown in Figure 1.

The supporters of Albrecht's theory of dual origin of the premaxilla have strained at demonstrating an 'interincisive suture to separate the endognathion from mesognathion. Others, including Biondi, have recognized an intra-alveolar suture passing in the frontal plane between the labial and lingual portions of the alveolar process of the incisive region. Felber and Thourén have asserted that an interalveolar suture separates the palatine process of the premax-

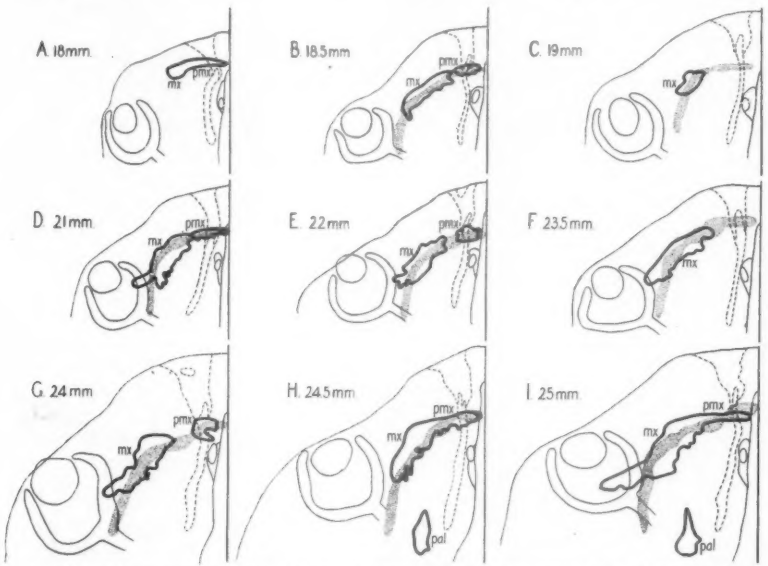

Fig. 2.—Graphic reconstructions (×12) of structures of left upper jaws of human embryos, projected onto the horizontal plane. The bones are heavily outlined. The dental lamina is stippled. The epithelial plug in the naris and the width of the nasal cavity at the level of and near the inferior border of the nasal septum are indicated by broken lines. The lens, retina, optic nerve, outline of face, nasal septum near its inferior border, paraseptal cartilage and vomeronasal organ are bounded by continuous light lines. ma, zygomatic bone; mx, maxilla; pal, palatine bone; pmx, premaxilla; pp, palatine process; vo, vomer.

illa from the body of that bone. And, to make the situation even more involved, such investigators as Inouye, Biondi, Bruni, Warynski and Thourén have recognized variant views, mostly modifications of those mentioned above.

In addition to the sutural relations in the alveolar process and palatine process, there must also be considered the relation of the premaxilla to the maxilla in the frontal process. Felber's investigation is the most impressive, since he made wax reconstructions of three stages of development. He followed the incisive suture in his 41.5 mm. stage through the entire height of the bone by lining up interrupted primary marrow spaces and thereby delimiting the premaxillary part from the maxillary part. Felber's figures of his model thus, in a sense, suggest strongly the condition found in mammals other than man.

In closing this brief historical review of the background of my problems, I should like to emphasize the fact that much of the investigation of the past has been instigated by a desire to explain the variable relations of teeth and their supporting bone to maxillary clefts. That much of that effort was misdirected is adequately and simply explained by Peter, who, more than a score of years ago, proved that the conditions responsible for cleft lip, jaw and palate are

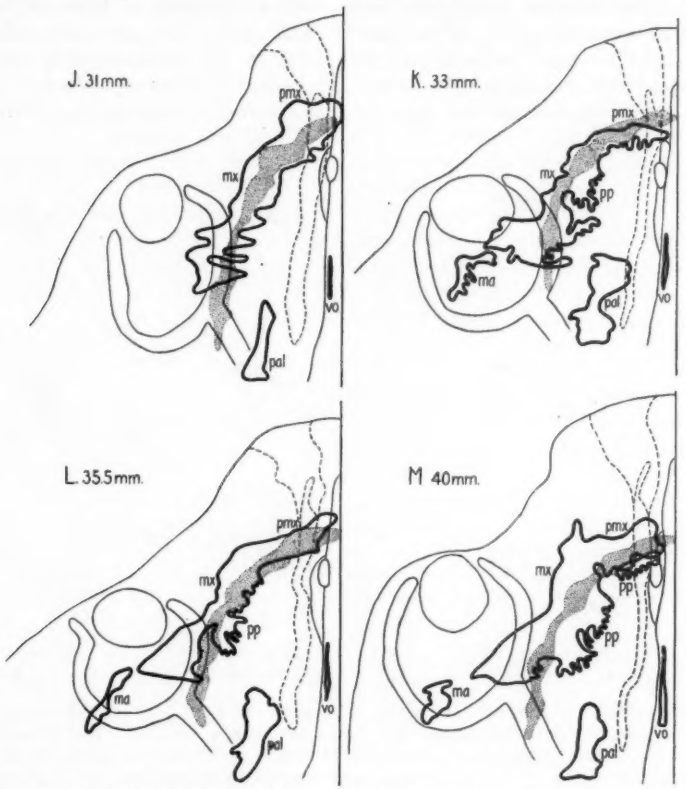

Fig. 3.—Graphic reconstructions, of structures of left upper jaws of human embryos. (See Fig. 2.)

present before the appearance of the formative tissues for either bones or teeth. Since this is so, the relations of bones and teeth to the cleft are secondary to the causative influence of the cleft.

In spite of this, there are still many problems to be solved regarding the relations of the premaxilla to its surroundings. Some of these are:

1. How many centers of ossification are involved?
2. Is there a separate ossification center for the palatine process of the premaxilla?
3. Is there a separate subvomerine center?
4. What is the normal time of inception of ossification?
5. Is more than an incisive suture involved in the normal early development of the premaxilla?
6. When and to what extent does the premaxilla of man fuse with the maxilla?
7. How much does the nasal process of the premaxilla contribute to the frontal process of the adult human maxilla?

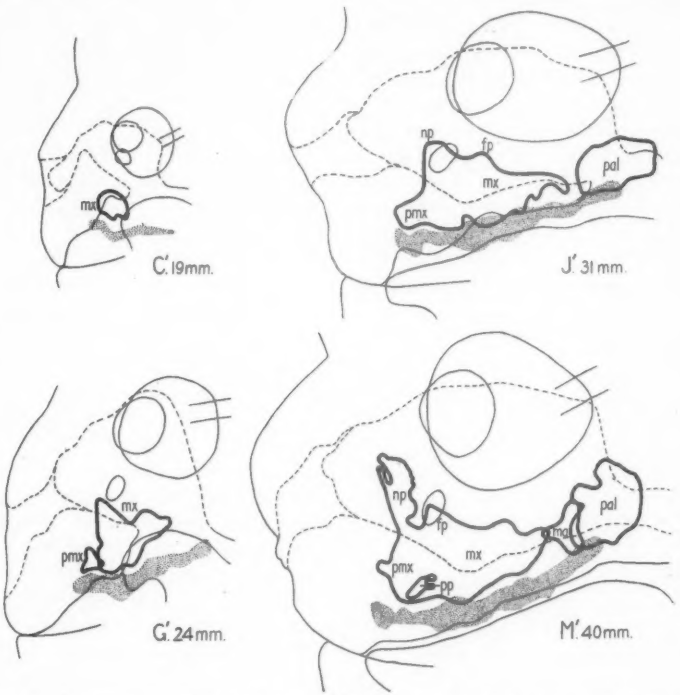

Fig. 4.—Graphic reconstructions (×12) of left upper jaws of four human embryos, projected onto sagittal plane. The bones are heavily outlined. The dental lamina is stippled. The epithelial plug and nasal cavity are in broken lines. Eye, nose, lips, roof of mouth, tongue and vomeronasal organ are lightly outlined. fp, frontal process of maxilla; ma, zygomatic bone; mx, maxilla; np, nasal (frontal) process of premaxilla; pal, palatine bone; pmx, premaxilla; pp, palatine process.

MATERIALS AND METHODS

In reviewing the published investigations of the past, I was impressed with the fact that most of the investigators dealt with only single embryos or with only spaced individual embryos covering a wide range of stages. Hence, it was

deemed desirable to study as many embryos as possible within a given limited range to observe the variations found within such a group.

The Western Reserve University collection includes thirty serially sectioned embryos from 15 to 40 mm. long. The range chosen included 15 mm. embryos because that length would be safely on the side of minimum length at which bone had previously been reported (Mall's 16 mm. stage). Data concerning these embryos and the condition of the bones in their upper jaws are presented in the accompanying table.

All six of the embryos of from 15 to 17 mm., two embryos of 18 mm. and one of 19 mm. showed no bone in the upper jaw. In the remaining twenty-one, bone was present.

For each of these twenty-one embryos, a graphic reconstruction was made, in

Fig. 5.—Graphic reconstructions (×12) of bones of upper jaw from 33-mm. and 35.5-mm. human embryos. The bones are heavily outlined. The vomeronasal organ is lightly outlined. (Abbreviations as in Figure 4.)

which the position and extent of the bone and its relation to the dental lamina, nasal cavity, vomeronasal organ, nasal septum and paraseptal cartilage were recorded by projection onto the horizontal plane. (Figs. 2 and 3.) These reconstructions do not take into account the level at which a given part lies, or its vertical dimensions. Hence, the result of each reconstruction is a group of outlines of silhouetted parts, much as in a roentgenographic record. They do show what bones are present, with their anteroposterior and lateral extent at cumulative horizontal levels and their position in the upper jaw with respect to other structures. Tracings of thirteen of these reconstructions are shown in Figures 2 and 3.

Because of the absence of vertical dimensions in the reconstructions described above, eight reconstructions from the side, that is, projected onto the sagittal plane, were made to show representative stages at 18, 19, 21.5, 24, 24.5, 26, 31 and 40 mm. Four of these are shown in Figure 4. Such reconstructions give the anteroposterior and vertical extent of the bones and their relation to the dental lamina, roof of the mouth, nasal cavity, vomeronasal organ, tongue and eye. Naturally, they lack the dimension of width.

Similar reconstructions of bones only of the upper jaw were made from six other embryos (20, 21, 21, 25, 33 and 35.5 mm. stages). Two of these are shown in Figure 5.

By combining the information gained by reconstructions in both the vertical and the horizontal planes, a fairly accurate record of the shape, extent and interrelation of the bones was obtained.

RESULTS

The data assembled in the table, concerning the first appearance of bone in the upper jaw, show the findings in this collection of embryos. No bone is present in any of the six embryos less than 18 mm. long, nor in two of the 18 mm. (577B, E284) and one of the 19 mm. (E396). The premaxilla is present in only two embryos less than 20 mm. long (9 and 513). It is lacking in two 21-mm. embryos (E357 and 403), in one 21.5-mm. embryo (432) and in one 23.5-mm. embryo (502). Except for the last mentioned specimen, in all the embryos longer than 21.5 mm. the premaxilla is present.

Embryos between 16 and 23.5 mm. represent the range of lengths during the eighth week and at the beginning of the ninth week of menstrual age. This range includes Mall's 16-mm. embryo, in which

he found a premaxillary center of ossification; hence, the premaxilla may appear at any time during the eighth week or be delayed until the early part of the ninth week. There is a marked tendency for the premaxilla to appear later than the maxilla, as evidenced by the absence of this bone in six of the twelve embryos of 18 to 23.5 mm. in which some bone was present. Examples of such cases are shown in Figure 2, C and F.

The center for the premaxilla and that for the maxilla may arise together (Fig. 2, A), or separately at about the same time. (Fig. 2, B, D, E, G.) In the latter case, the incisive suture which separates the two bones may be narrow or wide. (Compare B and D with E and G in Figure 2.)

Whatever their method of origin, the two centers have fused to a common mass before the 25-mm. stage. In this mass, the incisive suture is by no means plainly marked, either by the alinement of primary marrow spaces or by surface markings. An extremely variable notch in the palatine aspect between the parts of the dental lamina which will form the enamel organs of the lateral incisor and the canine becomes obvious only after the palatine processes of the premaxilla and maxilla have grown enough to deepen it, as in Figure 3, M.

In the vertical reconstructions, the

DATA ON EMBRYOS*

Identification	Length Mm.	Approximate Menstrual Age Weeks	Bones Present and Condition of Incisive Suture	Figure
570	15	7	No bone	—
197	15	7	No bone	—
652	15	7	No bone	—
E431	15.7	7	No bone	—
E285	16	8	No bone	—
E441	17	8	No bone	—
9	18	8	Pmx† and mx continuous	2A
577B	18ca	8	No bone	—
E284	18	8	No bone	—
607	18	8	Mx only (small)	—
513	18.5	8	Pmx and mx—definite suture	2B
491	19	8	Mx only	2C and 4C′
E396	19	8	No bone	—
322	20	8	Pmx and mx, definite suture	—
500	20.5	8	Pmx and mx, indefinite suture	—
E357	21	8	Mx only	—
403	21	8	Mx only	—
432	21.5	8	Mx only	—
E437	21ca	8	Pmx and mx, indefinite suture	2D
404	21.5	8	Pmx and mx, definite suture	—
20	22	8	Pmx and mx, wide suture	2E
502	23.5	9	Mx only	2F
569	24	9	Pmx and mx, wide suture	2G and 4G′
97	24.5	9	Pmx and mx, continuous, and pal	2H
520	25	9	Pmx and mx, continuous, and pal	2I
442	26	9	Pmx and mx, continuous, and pal	—
330	31	9	Pmx and mx, continuous, pal and vo	3J and 4J′
376	33	10	Pmx and mx, continuous, ma, pal and vo	3K and 5K′
400	35.5	10	Pmx and mx, continuous, ma, pal and vo	3L and 5L′
381	40	10	Pmx and mx, continuous, ma, pal, pp and vo	3M and 4M′

*From Western Reserve University collection.
†ma, zygomatic; mx, maxilla; pal, palatine; pmx, premaxilla; pp, palatine process; vo, vomer.

remains of the incisive suture are even more difficult to find and interpret. Apparently, the body and labial alveolar process of premaxilla and maxilla fuse, with no definite trace of a suture from the earliest fusion on.

With regard to the growth of the frontal process, the details of formation are extremely variable in individual embryos; yet, in spite of this variability, the end-result is the same. As long as the premaxilla remains separate from the maxilla, that is, up to the 24-mm. stage, there is little or no growth of a nasal process from the premaxilla. (Fig. 4, G′.) The maxilla, however, at about the 21-22 mm. stage, has sent up a tall, pointed, thin process to the approximate level of the vomeronasal organ, lying either somewhat anterior to the vomeronasal organ or opposite it. Later (in some embryos, at about the same time), a similar, shorter and blunter process farther back grows upward approximately below the lens of the eye. (Fig. 4, J′ and M′.)

The anterior taller process is the equivalent of the nasal process of the premaxilla of other mammals. It becomes the boundary of the piriform aperture and articulates with the nasal bone. The posterior shorter process is the equivalent of the frontal process of the maxilla, which forms the infra-orbital and frontal portions of the frontal process.

As soon as fusion of the premaxilla and the maxilla has occurred, the premaxilla contributes to the anterior process (NP), which grows upward toward the future position of the nasal bone faster than the posterior component. (FP in Fig. 4, J′ and M′; Fig. 5, K′ and L′.)

No definite suture is decipherable between these two processes. They appear to be formed in a single mass of osteogenic connective tissue. If any signs of a suture are demonstrable, they are no more than the alinement of primary marrow spaces, characterized by Felber as a zone of weak ossification. Fawcett's statement (1924) that these two processes are separate in embryos of 30 mm. is not corroborated by my series of embryos, unless he referred to only the distal ends of the processes. The 40-mm. embryo shown in Figure 4, M′, for example, has a deep notch between the two processes, but the part which lies below this notch is a continuous mass of bone.

The variable evidence of an open suture on the nasal aspect of the frontal process in the newborn must be of secondary origin, involving only the more internal layers of bone. The origin of such sutures, which is beyond the scope of this paper, is now under investigation.

Jarmer described a separately ossifying stenonian process in one of his two 40-mm. embryos. There is no sign of the stenonian process in the 40-mm. embryo of this group. A 41-mm. embryo, however, shows a slender process of bone on each side, projecting backward from the superior aspect of the palatine process of the premaxilla. These bony trabeculae, when cut in frontal sections near the tips, appear as separate ossicles, lying, as Jarmer's figure showed them, between the inferior ends of the paraseptal cartilages. If traced anteriorly, however, they can be proved to be in direct continuity with the bone of the premaxilla. They represent nothing more than the beginning of the nasal crests, which later articulate with the anterior, inferior border of the vomer. A 57-mm. embryo shows such processes extending forward to the anterior nasal spine and backward to the level of the incisive foramen. In a 70-mm. embryo, they have extended still farther posteriad and almost meet the anterior tip of the advancing vomer. In none of these three specimens is there any evidence of a separate origin for this bony ridge. On the other hand, one skull from a full-term fetus in our collection has a separate ossicle in the posterior part of the nasal crest of the left pre-

maxilla, though it has a continuous nasal crest on the right side.

From the foregoing evidence, it is probable that the stenonian processes, or subvomerine bones, should not be regarded as normal, separate ossification centers, but rather as aberrant ossicles forming in the nasal crest of the premaxilla. (Unfortunately, I have been unable to consult the writings of Rambaud and Renault, to whom Jarmer and Fawcett credit the description of these ossicles.)

The palatine process of the premaxilla may appear as early as the 24-mm. stage, at the time when fusion of the premaxilla and the maxilla is about to begin (Fig. 2, G and H), or it may be delayed, since neither the 25-mm. (Fig. 2, I) nor 26-mm. stage shows any. The process is formed by the growth of a few short trabeculae posteriad, with subsequent filling in of the intervals between the trabeculae by bone. The details of formation are highly variable, as is shown by the four reconstructions illustrated in Figure 3.

The 40-mm. stage (Fig. 3, M) has a separate center of ossification for the palatine process, a condition described as normal by Jarmer. On the other side of the same jaw, however, there is no separate center, nor is there one on either side of a 41-mm. embryo, which was examined but not reconstructed. Jarmer's Figure 3 shows a separate center on each side of a 40-mm. embryo, while his Figure 5 shows a separate center on one side, and a continuous palatine process on the other. Schwink (cited by Thourén) stated that, ordinarily, the palatine process grows from the same center as the rest of the premaxilla, but that occasionally a separate center is formed for the palatine process. On the basis of the evidence, a separate center is a common variant condition of little significance, since the mass of bone fuses shortly afterward with the body of the premaxilla or the rest of the palatine process.

Concerning the sutural relations, the incisive suture is represented by a deep, narrow notch in the palatine process in the 40-mm. stage. (Fig. 3, M.) In the 31-mm., 33-mm. and 35.5-mm. stages (Fig. 4, J′, Fig. 5, K′, L′), however, there is no marked evidence of such a suture. In sections, there is a zone in which there are fewer trabeculae lying just laterad from the region of the lateral incisor, but no continuous suture. Apparently, just as an incisive suture is found in the palatine process of the new-born and the fetus of later months of pregnancy, but not in the labial alveolar process or body of the maxilla, the "open" incisive suture is limited to the palatine process even in such early stages as 40 mm.

The claims for interincisive, intraalveolar and interalveolar sutures mentioned in the historical review are not supported by the findings in this series of embryos unless the transitory suture between a separately ossifying center for the palatine process and the body of the premaxilla is regarded as the equivalent of Felber's interalveolar suture. The inconstant notch between central and lateral incisive regions (Fig. 3, M) is due to the tendency toward somewhat earlier formation of the trabeculae of bone of the palatine process in the immediate vicinity of a tooth-germ, where also the alveolar process is higher. The evidence supports the contention of Vallois that such a notch is no interincisive suture, but rather an ephemeral incisure associated with growth of the germs of the incisors.

Throughout this investigation, I have been impressed by the great variability of details of development of the bones as compared with the striking comparative uniformity of other structures. Figures 2 and 3 show less than two-thirds of the reconstructions made in a horizontal plane; Figures 4 and 5, less than half of

the bones reconstructed vertically. When all of the reconstructions are displayed in orderly age sequence, in spite of the variations, the whole procedure of jaw formation is seen to be an essentially orderly approach toward its goal. The graphic survey of a relatively short period of development thus afforded leads to the conviction that much of the controversial complexity of the past has been due to chance selection of individual variant or aberrant stages, which could easily lead to misinterpretation.

SUMMARY AND CONCLUSIONS

The human premaxilla begins ossification at any time in the eighth week or in the early part of the ninth week of intrauterine life. It usually appears shortly after the maxillary center of ossification, but may arise at the same time. Ordinarily, it is separated from the maxilla by a narrow or wide suture representing the incisive suture, but may rarely appear at the beginning, fused with the maxilla.

The body and labial alveolar process fuse with the maxilla normally before the middle of the ninth week. Before fusion occurs, the frontal process is formed from the maxilla. The premaxillary part of this process is contributed after fusion. At no stage is there an open suture between the premaxillary and maxillary components of the frontal process. The fusion is more nearly complete at the facial aspect than it is toward the nasal cavity.

The palatine process usually grows directly from the body, but a separate ossification center is a common variation.

The stenonian process of Jarmer or prevomerine center of Fawcett is not normally a separate ossification center, but an aberrant center in the nasal crest of the premaxilla.

The incisive suture is closed in the body, labial alveolar process and facial aspect of the frontal process from the early stages on. It remains open to a variable extent in the palatine process and perhaps along the nasal aspect throughout development.

Essentially, the premaxilla is formed from a single ossification center on each side. The only expressions of more than one center are the apparently common separate ossification of the palatine process and the probably less common appearance of an ossicle in the nasal crest.

There is no interincisive suture and no intra-alveolar suture.

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CORRELATION AND COMPARISON OF LABORATORY FINDINGS WITH THE CLINICAL EVIDENCE OF CARIES ACTIVITY IN A GROUP OF SIXTY-SIX CHILDREN

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A DIRECT correlation between the numbers of lactobacilli, as quantitatively determined in the saliva, and caries activity has already been established.[1, 2, 3, 4, 5] A simple colorimetric method to determine roughly these figures has also been described,[6] but it was concluded that the color changes, because they reflected acid production by all the bacteria in the saliva, could not be interpreted in terms of numbers of lactobacilli only. Since acid production *in vivo* is the key to decalcification, it seemed that any method designed to detect this factor should give more accurate results than those which are open to all the objections to viable plate counts. To obtain such information, a group of children was studied for slightly more than two years by collecting their saliva periodically, culturing these specimens by both laboratory methods and correlating the laboratory findings with the clinical evidence of caries activity, as well as evaluating the methods in respect to each other. A portion of this material has already been reported,[7] but, with the completion of the project, it seemed important to make a detailed description of the material and the associated problems since little or no information of this nature is available in the dental literature.

From the Hygienic Laboratory, University of Michigan.

MATERIALS AND METHODS

Children from the University of Michigan Elementary School were selected as subjects because their dental development is studied during the school year by clinical examinations, fall and spring, roentgenograms and anthropologic measurements. It was easy, therefore, to establish a systematic laboratory investigation which could be readily correlated with the clinical records of this group.

This study began in February 1939 and was finished in May 1941. The majority of the children were in the kindergarten and first, second and third grades. Whenever possible, samples were obtained from the same individuals throughout the period, but since, in many instances, children dropped out of

school and were replaced by new ones, only those children who had records from four of the seven possible clinical examinations (October 1938-November 1941), which served as the time limits for correlative purposes, were included in this report. The total number of subjects was sixty-six. The minimum length of time covered by the clinical and laboratory data was eighteen and fourteen months, respectively. The average number of specimens of saliva was twelve per child.

The specimens of saliva were collected at approximately monthly intervals during the school year. Paraffin tablets were given to the children to chew, with instructions to contact as many of the tooth surfaces as possible. The usual three-minute sample was sought, but, in many cases, more or less time was taken, depending on the cooperation of the child. However, the standardization of this step is seemingly unnecessary since it has been found, in freshman medical classes, that alternate individuals not chewing wax give as high lactobacillus counts as those who chew the tablets. The younger children in general produced smaller volumes of saliva. Owing to the routine of the school, all specimens of saliva were collected between 8:15 and 9:15 a.m., after which they were taken to the laboratory and cultured within two hours by both colorimetric and plating methods.

The samples were shaken vigorously. For the colorimetric technic, 0.1-0.2 milliliters of each specimen of saliva was transferred by pipe to correspondingly labeled tubes of melted glucose agar* (pH 4.7-5-0), containing bromcresol-

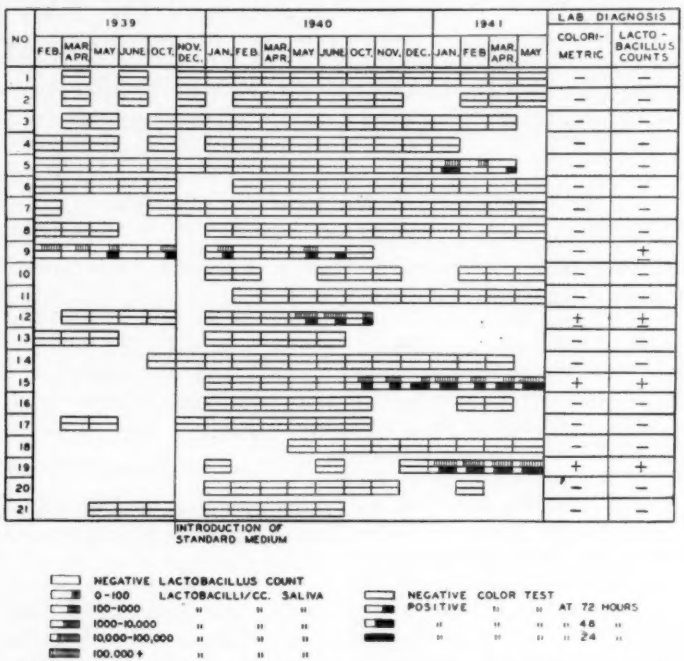

Fig. 1.—Correlation of laboratory data with clinical evidence of caries activity in clinically negative cases.

*Bulk of this medium furnished by Difco Laboratories, Detroit, Mich., under name of bromcresol green dextrose agar.

green as the indicator, held at 50° C. The inoculum was mixed by rotation and the agar allowed to solidify, after which they were incubated at 37° C. Observations were made daily at first up to ninety-six hours, later to seventy-two hours, to determine the gradations in color which, as acid is produced, go from the initial bluish green to a distinct yellow. On the basis of previous experience, only those reactions in which green was no longer the dominant color (below pH 4.2) were recorded as positive.

To obtain lactobacillus counts, the technic of Hadley[8] was followed essentially. From the same sample as before, 0.1-0.2 milliliters of saliva was placed on a tomato-peptone-agar plate and smeared over the surface with a sterile bent glass rod, and an additional 0.6-0.8 milliliters of the specimen was placed in acid glucose broth (pH 5.0). All cultures were incubated at 37° C. The glucose broth was examined microscopically in forty-eight hours to determine whether gram-positive rods were present. The plates were observed at the end of ninety-six hours, at which time the number of characteristic morphologic colonies of lactobacilli was estimated with the aid of a binocular dissecting microscope.

Interpretation of the laboratory findings in respect to caries activity was made as follows: Constant absence or occasional presence of lactobacilli and positive color reactions were considered to be indicative of negative caries activity, whereas the constant presence of lactobacilli and positive color reactions or intermittent negative periods was held to signify caries activity. Although these results were essentially qualitative and merely established whether caries activity existed, an attempt was also made to compare the methods on the basis that caries activity is in general directly related to the number of lactobacilli in the saliva and inversely proportional to the time required for positive color reactions. In respect to the colorimetric technic, previous experience showed that the rate of color change could be thus interpreted:

No color changes in seventy-two hours: negative caries activity.

Positive color tests in seventy-two hours: questionable caries activity.

Positive color tests in forty-eight hours: definite caries activity.

Positive color tests in twenty-four hours: marked caries activity.

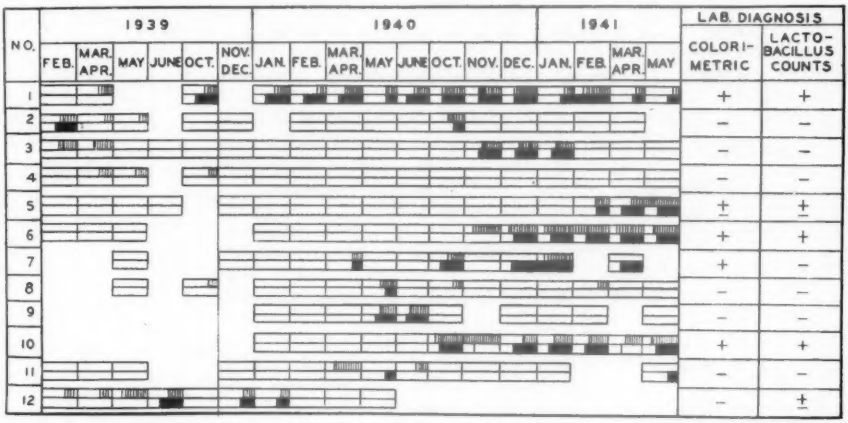

Fig. 2.—Correlation of laboratory data with clinical evidence of caries activity in clinically questionable cases.

CORRELATION OF LABORATORY FINDINGS WITH CLINICAL EVIDENCE OF CARIES ACTIVITY

These data were correlated with the clinical evidence of caries activity. The diagnosis of the examiners was made after a review of the summarized individual clinical record. For the name, a number had been substituted. The examiners were asked to divide the group on the basis of summation of clinical activity: first, the clinically negative, or those children who had no demonstrable lesions throughout the time of study; second, the clinically questionable, or those who had either a past history of caries activity as shown by cavities or fillings and who showed no changes during the study or such alterations as could be listed only as suspicious, and, third, the clinically active cases or those in which definite changes occurred as shown by the appearance of new cavities or a marked increase in the number of fillings.

These estimates, with a comparison of the efficacy of the laboratory findings, are presented for the clinically negative cases in Figure 1.

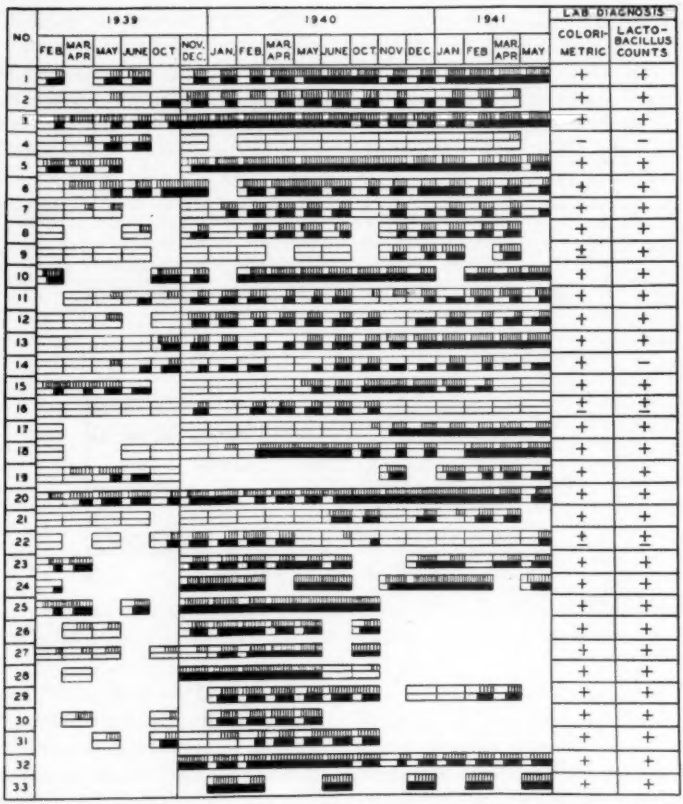

Fig. 3.—Correlation of laboratory data with clinical evidence of caries activity in clinically positive cases.

The outstanding feature of Figure 1 is the clearcut relationship existing between the negativeness of the laboratory and of the clinical findings; that is, in sixteen

of the twenty-one clinically negative cases, lactobacilli were not demonstrable in the saliva in any of the specimens obtained, and the bacterial flora was also not capable of producing acid in the bromcresol-green-dextrose-agar. Of the five cases that had positive laboratory cultures, No. 5 showed so little that it was considered negative; No. 9 was deemed suspicious or questionable as regards the more or less continued presence of lactobacilli, but the intermittent color reactions did not seem significant; No. 12 was listed as questionable by both methods, since consecutive positive findings were recorded only at the end, and Nos. 15 and 19 were held to be active by both methods even though the clinical examinations made the following November were still negative for caries. The importance of following up these cases cannot be overemphasized.

The clinical and laboratory findings for the clinically questionable group are given in Figure 2.

In Figure 2, it is apparent that there is an increase in positive cultural results, which should be expected because of the criteria used in defining the group. However, the majority had negative laboratory reactions, and, on reexamination of the clinical records, it was found that most of the children belonged to the group which showed no clinical change over that first recorded. Actually, these cases are clinically negative, but, for our purposes, they are placed in the questionable section. Only No. 1 is of special interest. This case, although consistently showing lactobacilli in the saliva and an ability of the oral bacteria to react positively to color tests, was clinically negative in the spring examination of 1941. The child dropped out of school in June,

TABLE 1.—CORRELATION BETWEEN CLINICAL AND LABORATORY DIAGNOSIS OF CARIES ACTIVITY

Summation of Clinical Activity	Number of Children	Laboratory Diagnosis					
		Negative		Questionable		Active	
		Color	Lactobacillus	Color	Lactobacillus	Color	Lactobacillus
Negative	21	18	17	1	2	2	2
Questionable	12	7	7	1	2	4	3
Active	33	1	2	3	2	29	29

TABLE 2.—COMPARISON OF INCIDENCE OF LACTOBACILLUS IN SPECIMENS OF SALIVA WITH ACID PRODUCTION IN BROMCRESOL GREEN-DEXTROSE-AGAR (pH 4.7-5.0) INOCULATED WITH 0.1-0.2 CC. OF SALIVA

Summation Clinical Activities	Number Subject	Number Specimen	Positive Lactobacillus		Positive Color Reactions (Hours)					
					24		48		72	
			No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Negative	21	241	22	9	0	0	8	3	21	9
Questionable	12	150	59	39	2	1	32	21	44	29
Active	33	453	329	73	98	22	251	55	321	71
		844								

but was brought to the dental school for a clinical examination (by Dorothy G. Hard) in the fall, at which time three suspicious areas were found.

The clinical and laboratory data for the clinically active group are presented in Figure 3.

The contrast between the laboratory findings in the clinically active group some months after these cultural findings. It is very likely that these positive reactions occurred either at the end of an active period or the beginning of a short period of activity which lasted through the summer of 1939, to be followed later by the new cavity and an increase in number of fillings. Another (No. 14) was of interest because of the infrequency of

TABLE 3.—COMPARISON OF INCIDENCE OF LACTOBACILLUS IN SPECIMENS OF SALIVA WITH ACID PRODUCTION IN STANDARD BROMCRESOL GREEN-DEXTROSE-AGAR (pH 4.75) INOCULATED WITH 0.2 CC. OF SALIVA

Summation Clinical Activities	Number Subject	Number Specimen	Positive Lactobacillus		Positive Color Reactions (Hours)					
					24		48		72	
			No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Negative	21	198	18	9	0	0	8	14	16	8
Questionable	12	116	44	38	2	2	29	25	41	35
Active	33	352	278	79	96	32	229	65	282	80
		666								

TABLE 4.—COMPARISON OF PERCENTAGES OF POSITIVE COLOR REACTIONS AND INCIDENCE OF LACTOBACILLUS IN SPECIMENS OF SALIVA

Summation Clinical Activity	Specimens Positive Lactobacillus		Positive Color Reactions (Per Cent)		
	No.	Per Cent	24	48	72
Negative	18	100	0	44	89
Questionable	44	100	5	66	92
Active	278	100	35	82	101

and those of the clinically negative group (Fig. 1) is vividly shown in Figure 3. In this chart may be noted the constant presence of lactobacilli in certain children, a change from a negative to a positive condition in others and evidence of a cycle in a few. Only one child (No. 4) failed to show lactobacilli or an ability of the oral flora to produce acid other than on three successive occasions early in the study, and the case was called negative by both methods. However, examination of the clinical record showed that the new lesions were demonstrable lactobacilli, although positive color reactions were almost constant.

The data of these charts are summarized in Table 1, in respect to the correlation of clinical and laboratory diagnosis of caries activity.

Table 1 shows that both laboratory methods gave results closely resembling those describing the clinical state. In fact, the X^2 value in this table is 47.22, a figure not found in the ordinary statistical table, so that the probability of these being chance findings is extremely remote. Omitting the questionable

group, this correlation is excellent for biologic procedures. These figures support the claim of Bunting and his associates that, with the number of lactobacilli in the saliva as an index, it is possible to reach a 90 per cent or greater accuracy of diagnosis as compared with the clinical records.

CORRELATIVE FINDINGS

Although the relationship between acid production and numbers of lactobacilli in the saliva and the clinical evidence of caries activity is clearly established by the periodic data presented, there are several problems associated with this study that need some explanation.

First is the number of subjects required. The children were taken at an early age in order to avoid as nearly as possible the presence of caries, although no attempt was made to select these subjects on that basis. Just how many children must be subjected to sampling, and how many times over so long a period, to provide sufficient data from which to draw adequate conclusions may be debatable, but they should be numerous enough that the results either do not change to any extent the curves already established or else are reproducible at any time. The statistical aspect of a longitudinal study in contrast to cross-sectional data has been admirably developed by Shuttleworth,[9] and it was shown that ten children measured ten consecutive times gave height curves of much more nearly uniform nature than many hundreds of random measurements of children in the same age group. Trevan[10]

TABLE 5.—COMPARISON OF FREQUENCY AND TIME OF COLOR REACTIONS IN STANDARD BROMCRESOL GREEN-DEXTROSE-AGAR (pH 4.75) WITH LACTOBACILLUS COUNTS IN RESPECTIVE SPECIMENS OF SALIVA

Summation Clinical Activity	Number Subjects	Lactobacillus Counts	Number Specimens	Positive Color Reactions (Hours)					
				24		48		72	
				No.	Per Cent	No.	Per Cent	No.	Per Cent
Negative	21	0	180	0	0	0	0	2	1
		0-100	1	0	0	1		1	
		100-1,000	3	0	0	2	67	3	100
		1,000-10,000	6	0	0	1	16	6	100
		10,000-100,000	8	0	0	6	75	8	100
			198						
Questionable	12	0	72	0	0	2	3	4	6
		0-100	9	0	0	1	11	7	78
		100-1,000	12	0	0	5	58	11	90
		1,000-10,000	11	1	9	11	100	11	100
		10,000-100,000	9	0	0	7	78	7	78
		100,000	3	0	0	3	100	3	100
			116						
Active	33	0	74	0	0	8	11	16	22
		0-100	14	0	0	2	14	6	36
		100-1,000	36	0	0	28	78	32	89
		1,000-10,000	97	14	14	82	82	91	95
		10,000-100,000	93	49	53	90	98	93	100
		100,000	38	33	87	38	100	38	100
			352						

has also demonstrated that, for bio-assay, significant results can be obtained with thirty animals. It seemed, therefore, that sixty or more individuals represented a sufficient number for the present study.

Second, selection of a greater span of time for the clinical phase than for the laboratory study was necessary. When the laboratory work was started in February 1939, a special series of clinical examinations were made. Although these could be used as a starting point, it seemed that if the investigation was sufficiently extended, the clinical changes recorded in the interval between the usual fall examinations (October 1938) and the special ones would be rendered insignificant by the normal course of repetitive clinical examinations. Also, since dental caries is a process and lesions are found only after the appearance of lactobacilli in the mouth, it was felt that if the routine examinations (November 1941) following cessation of the laboratory study (May 1941) were used for correlative purposes, a more nearly accurate correlation between laboratory findings and clinical evidence of caries activity could be obtained. Thus, the clinical records covered the time between October 1938 and November 1941, as contrasted with the laboratory data, which were collected from February 1939 to May 1941.

Third, the accuracy of the clinical examinations should be considered. The possibilities of error in this procedure have been reviewed by Radusch.[11] In this school, a graduate student in orthodontia was the dental examiner. Two individuals, one a successor to the other, held this position during this period. When the clinical records were summarized, it was found that teeth, cavities and fillings had strange ways of appearing and disappearing, but repeated examinations eliminated these apparent errors, so that it was possible to select those cases that were caries active with a very small chance of error.

Fourth, the elimination of the personal factor in correlating laboratory and clinical data was a problem which was met by listing for each child in terms of cavities, fillings and recurrent decay the complete clinical information from October 1938 to November 1941, or to the termination of attendance at the school. For the name, a number was substituted, and the data were given to the two individuals who had conducted the examinations. They were asked to divide the children into groups on the basis of summation of clinical activity as already defined for these children. It was with these estimates that laboratory findings were correlated.

Aside from these problems, an evaluation of the material presented makes it appear that the greatest service of the charts would be to emphasize a feature too often ignored in dental caries: the time that must pass between the first appearance of the organisms, whether they be lactobacilli or not, and the finding of grossly demonstrable lesions. This condition is simulated by none of the acute diseases of man or of animals. The best analogies are the chronic diseases, tuberculosis and leprosy, where months or years may pass before clinical symptoms are evident. Unlike these conditions, which are marked by characteristic cellular changes that are diagnostic, the decalcification of the enamel and dentin is merely the dissolution of relatively inert structures in which no evidence of repair or protection by cellular elements is found. It is essentially an injury rather than a true infection. Nevertheless, all analogies of individual resistance, carrier stage and active state are possible and undoubtedly may be used to explain many of the apparent anomalies that occur when an attempt is made to correlate the presence or absence of any organism with this process. With these facts in mind, it becomes clear that the establishment of any one organism as the etiologic agent in dental caries is most

difficult, but, up to the present, no data for any species other than the lactobacilli have been satisfactorily established.

COMPARISON OF LABORATORY METHODS

To turn now to a consideration of the laboratory phase, it is apparent that the color test reflects acid production by all the bacteria inoculated with the saliva. This production cannot be translated directly in terms of numbers of any one species, but it has been shown[12] that, with pure cultures and mixtures of oral streptococci, yeastlike forms, staphylococci and smooth types of lactobacilli, only the lactobacilli were capable of turning the medium yellow in twenty-four hours. With the relatively large inocula used, a few strains of staphylococci gave positive color reactions in forty-eight hours, but neither the yeastlike forms nor the streptococci were able to alter the medium in ninety-six hours. Even accepting the possibility that a few of the positive color reactions may be given by other bacteria alone or in action with the complex flora of the saliva, it may be taken for all practical purposes that these color reactions were caused by lactobacilli. Therefore, the colorimetric method having been found as accurate as lactobacillus counts for the laboratory diagnosis of caries activity, it was now possible to compare these procedures so that they could be evaluated in respect to each other.

As will be noted in the charts, a line indicated the introduction of a standard medium in November 1939. Before that time, the medium was made as needed from infusion broth, and some trials were also made with various amounts of inoculum. Since the dehydrated agar was found to be very satisfactory and its use eliminated several variables, this bromcresol green-dextrose-agar was employed routinely with a constant amount, 0.2 milliliter, of saliva as the inoculum. It was thought of interest, however, to summarize the results for the total as well as for the standard medium, which was used for four-fifths of the number of specimens tested. The data are given in Tables 2 and 3.

These tables show the same trend in respect to the increase of incidence of lactobacillus in the saliva of the clinically active group and the frequency of positive color reactions. These figures illustrate the difficulty of presenting periodic findings in a single table; that is, if these figures were to be considered alone to establish the correlation of the lactobacillus or acid production with the clinical picture, an account must be made for the discrepancy that exists between the presence of positive findings in the clinically negative group and the absence of positive cultures in the clinically active group. The explanation is given in the charts that have been discussed, to indicate the transition of individuals from one clinical state to another.

One of the advantages of the colorimetric technic is the rapidity with which significant results can be obtained. On the basis that the color changes are induced by the lactobacillus, it is of interest to compare the two methods in respect to positive findings, and these results are expressed as percentages in Table 4.

This table indicates that half or more of the specimens of saliva yielding lactobacilli by plate counts will give positive color reactions in forty-eight hours and 90 per cent in seventy-two hours. In cases that are clinically active, 80 per cent gave positive reactions in forty-eight hours, while 35 per cent did so in twenty-four hours. These are essentially qualitative findings, which, on being broken down by comparison on a quantitative basis, are even more interesting. These data are given in Table 5.

Table 5 shows clearly that the failure of the indicator to change color as a result of acid production is closely related to negative lactobacillus counts, regardless of the clinical condition. Like-

wise, it is apparent with lactobacillus counts over 100 per milliliter of saliva, except in the clinically negative group, that a very large percentage of positive color reactions occur in forty-eight hours. Possibly more striking are the readings in the 24-hour interval, where many of the specimens containing more than 10,000 lactobacilli per milliliter of saliva gave positive color reactions.

It may be accepted, therefore, that positive color reactions in general appear earlier with increasing numbers of lactobacilli in the saliva, but a comparison of the twenty-four hour readings would suggest that numbers alone were not responsible. If that were the case, a proportional number of positive color reactions should be expected even in the few specimens containing more than 10,000 lactobacilli per milliliter of saliva from the clinically negative or questionable groups. This feature was not observed.

DISCUSSION

This study was made primarily to test by periodic sampling of a group of cases the efficacy of the colorimetric method as an aid in the laboratory diagnosis of caries activity as established by clinical examinations. The children were taken at an early age to avoid as nearly as possible the presence of caries, and were followed until it was believed that the data, which were obtained from the sixty-six children who were sampled on an average of twelve times between the initial and final examinations, did not alter significantly the figures reported at what may now be defined as the halfway mark.[12]

These periodic findings, which are presented in the charts, illustrate better than any statement the difficulty of diagnosing caries activity by any single examination, clinical or otherwise; yet, when sufficient time with frequent sampling is allowed, the progress of the clinical condition is remarkably reflected by the laboratory findings. The study showed once again that lesions did not occur in the absence of lactobacilli or acid production and that the sporadic appearance of lactobacilli or positive color reactions is of little significance, but, with the relatively constant finding of lactobacilli or positive color reactions, sooner or later clinical lesions will be found. It is suggested, therefore, that the dentist could better evaluate caries activity and the treatment necessary by routinely culturing the specimens of saliva from his patients.

During the time that the colorimetric technic was being developed, the interesting papers of Fosdick and his associates[13, 14, 15, 16] on the symbiotic influence of yeast organisms on lactic acid production by lactobacilli began to appear. These lent support to the contention that since acid formation *in vivo* is the key to decalcification, any method that utilizes this feature should be more accurate for the laboratory diagnosis of caries activity than lactobacillus counts. In addition, plate counts do not give any information about the acidogenic powers of any one of the morphologic types present in the inoculum.[17] This matter becomes important in respect to the view, advocated by Jay, that the number of lesions is proportional to the numbers of lactobacilli in the saliva regardless of their morphologic types; that is, the increasing numbers of lactobacilli in the saliva represent more areas from which they are dislodged by the chewing of wax.

This concept is open to several criticisms, the most important of which concern the errors associated with plate counts, which may reach a thousand per cent,[18] and the assumption that the organisms are equally distributed in or removed from the lesions. For that matter, it is possible to have the same amount of decalcification by small numbers of highly acidogenic varieties of lactobacilli (smooth types) as by large numbers of less active acid-producing

lactobacilli (rough types). Although this study showed the methods to be the same for qualitative results, an attempt was made to test the validity of this theory. It failed because of the errors in the clinical records and because no control could be exerted over the private dental treatment received; but, in several instances, there was no greater increase in the number of new cavities recorded with consistently high counts than with lower numbers. Information of this nature must be obtained with a group that can be controlled, with clinical examinations and treatment by the same persons.

However, when it comes to the matter of practicality, the advantages of the colorimetric method are obvious: it is simple, rapid and accurate, and requires little laboratory apparatus or special skill. Positive results can be obtained in from one-fourth to one-half the time necessary for lactobacillus counts. Although little has been done with the procedure as a method of testing the value of diet therapy in the control of caries activity, it seems logical, from the data presented, that any procedure which would change the rate of acid production so that color reactions are delayed on the average of twenty-four hours should be followed by clinical improvement.

SUMMARY

A group of children have been studied for a little more than two years to correlate the lactobacillus counts and the acid-production reflected by color changes in a selective agar medium with the caries activity determined by clinical examinations. According to these two laboratory methods, the same cases were clinically active or negative, with an accuracy of 90 per cent. The rate and frequency of positive color reactions are in general inversely proportional to the numbers of lactobacilli in the saliva, but it is apparent that numbers alone are not the controlling factor. The chief advantages of the colorimetric technic is its simplicity, rapidity and accuracy, which allows the easy determination of the extremes of caries activity.

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EFFECT OF VARIOUS FOODS AND CLEANSING AGENTS ON THE ELIMINATION OF ARTIFICIALLY INOCULATED YEAST FROM THE MOUTH

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INTRODUCTION

Hirschfeld (1939) stated that the chief requirements for maximum oral hygiene are a satisfactory toothbrush and an effective method of brushing. The experiments of Howitt, Fleming and Simonton (1928) suggested a greater relative effectiveness of the toothbrush over "presumptively" detergent diets. Wallace (1929), on the other hand, placed more emphasis on the action of detergent foods and the cleansing effect of saliva, but did agree that intelligent use of the toothbrush was helpful.

Both Hirschfeld (1939) and Wallace (1929) stressed the advantages of substituting detergent fruits and vegetables for carbohydrate rich foods which tend to be impacted or retained on different areas of the teeth. Wallace (1929) further stated that if a food which may otherwise be destructive is followed by a sufficient amount of a cleansing food, there are no harmful results.

Observations of Fancher and Fosdick (1941) indicated that, in many cases, lactic acid is formed in isolated spots with extreme rapidity after ingestion of sugars. Teuscher (1937) found that the rate at which sugar disappeared from saliva was lower in persons more susceptible to caries. Thus, it seems desirable to have information regarding both the speed and the effectiveness of natural and artificial means of cleansing the mouth.

Many reports relative to oral hygiene are based on disappearance of bacteria from the mouth. It has been shown that massive amounts of artificially inoculated bacteria may disappear from the mouth in from one to four hours. (Hood and Arnold [1937]; Bloomfield [1922].)

Bloomfield (1922) concluded that there is a definite mechanism whereby foreign organisms entering the mouth are removed. The essential feature of the mechanism was a rapid and direct conveyance of the bacteria toward the throat. Bloomfield (1922) also reported that organisms once anchored on mucous membrane were no longer easily dislodged by flushing with fluids.

Appleton, Klein and Palmer (1938) found that while artificially inoculated bacteria *(Serratia marcescens)* were always eliminated from the mouth, the time required for elimination was greater when large amounts were inoculated. Additional interesting observations of Appleton (1940) are:

1. Experiments with pilocarpine and paraffin indicated that an increased salivary flow and the mechanical effects of chewing paraffin markedly accelerated the elimination of artificially inoculated bacteria.

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2. The chewing of food, with the accompanying increase in salivary flow, and the mechanical effects of friction and swallowing resulted in the removal of large numbers of bacteria from the mouth.

The decrease in the normal flora following various cleansing methods is temporary. Florestano, Elliott and Faber (1941) for instance, reported a 46 to 89 per cent reduction of oral organisms following prophylaxis with water, citrus fruits and detergent tooth pastes, with a distinct rise above normal in all cases two hours later. It was interesting to note that the rise following the use of orange juice was less pronounced.

OUTLINE OF EXPERIMENTAL METHOD EMPLOYED

It was the aim of these experiments to compare the effectiveness of several foods and artificial cleansing agents as aids to the natural cleansing mechanism of the mouth.

Any satisfactory experimental method for such an evaluation should take into consideration and allow for the free interplay of biologic and physiologic factors. It is then evident that, in experiments of this type dealing with the mouth, one may expect many difficulties. The development of the method finally used was the result of many preliminary experiments.

TABLE 1.—ORAL HEALTH DATA

Subject	Missing Teeth	Bridges: Fixed	Bridges: Removable	Cavities	Condition of Gingivae
E.P.	1: | / 7|			3 small	Moderate amount of calculus
H.J.	6: |3-5 / 7-6|6-7	1: |3-4		4 small 2 small	Marked inflammation
H.K.	7: 8-5-1|6 / 5|1-6	2: 1|1 / 1|1-2		3 small	Marked general recession
L.K.	7: 8|8 / 6|5-6-7-8			—	Good
J.O.	6: 6-4-5|7-8 / |7	1: 6-5-4|7 / |		—	Good
E.L.	9: 8-6|6-8 / 6-5|5-6-8	—		—	Good
A.H.	6: 8|8 / 7-6|5-6	—	—	3 small	Marked gingivitis
G.D.	9: 8|4-5-8 / 8-6-5-4|8	| 1: 1: 6-5-4|	|4-5	—	Good
G.V.	4: 8|8 / 8|8	—	—	1 small	Good
P.R.	7: 7|6-8 / 6|4-5-6	— 2: |6 / |4-5-6		—	Good

Following is an outline of the experimental method used:

1. The subject was required to eat a cake of yeast (Fleischman's), distributing the material throughout the mouth with the tongue. He was then asked to refrain from eating or drinking for two hours.

2. Two hours after the yeast was eaten, a piece of paraffin weighing 2.5 gm. was chewed for three minutes and the saliva was collected in a sterile test tube.

3. The specimens of saliva were diluted in sterile 0.85 per cent sodium chloride and 0.1 cc. amounts of the required dilutions were distributed evenly over each of two Sabouraud's agar plates with a smooth glass rod. Dilutions were made in multiples of 5, 10 or 50 in order to have two dilutions containing from fifty to 500 viable organisms per cubic centimeter.

4. The plates were incubated at 37° C. for forty-eight hours and colonies containing yeast were counted and multiplied by the dilution factor. The average obtained from plates containing from fifty to 500 colonies was recorded.

Since the chewing of paraffin in collecting samples served to remove the inoculated yeast, only one determination a day could be made. However, at least three tests were made on separate days, and the average of all the tests was taken as the control factor. This control factor represented the approximate number of yeast organisms contained in 1 cc. of the paraffin-stimulated saliva, if no artificial aid was used to cleanse the mouth.

In evaluating the added cleansing effect of the substances in question, the tests given below were started one hour after eating the yeast cakes. The saliva samples were taken as previously described two hours after the yeast was eaten. At least three separate tests were made for each substance on the same individual and the average of the resulting plate counts was compared with control counts for that individual.

TABLE 2.—AVERAGE NUMBER OF YEAST CELLS PER CUBIC CENTIMETER OF SALIVA SAMPLES OBTAINED FROM PATIENT E.P. TWO HOURS AFTER YEAST CAKE WAS EATEN

Tests Started One Hour After Eating Yeast	Tests	High	Low	Average	Reduction Per Cent*
Control (i.e., no test before taking sample)	4	3,250,000	1,850,000	2,294,000	
180-200 gm. of apple eaten	3	170,000	35,000	87,700	96.2
2.5 gm. paraffin chewed thirty minutes	3	130,000	50,000	103,300	95.5
65 gm. chewy candy eaten	3	180,000	70,000	115,000	95.0
225 gm. orange (sliced) eaten	3	175,000	75,000	116,600	94.9
1 stick gum chewed thirty minutes	3	325,000	40,000	265,000	88.4
150 gm. ripe banana eaten	3	1,450,000	650,000	852,000	62.9
225 gm. orange eaten (with spoon)	3	1,700,000	900,000	1,200,000	47.7
Teeth brushed three minutes with paste; water rinse	3	1,600,000	1,112,000	1,313,000	42.8

*Based on control average.

Subjects were required to make the following tests:

1. Brush the teeth for three minutes with toothbrush and toothpaste and then rinse the mouth with approximately 150 cc. of tap water.

2. Chew 2.5 gm. of paraffin for thirty minutes.

3. Chew 1 stick of chewing gum for thirty minutes.

4. Eat from 180 to 200 gm. of a firm winesap apple.

5. Eat from 225 to 250 gm. of sliced orange.

6. Eat a 225 to 250 gm. orange with a spoon.

7. Eat from 140 to 150 gm. of ripe banana.

8. Eat from 60 to 65 gm. of a chewy candy bar.

A total of 210 tests were made on ten subjects over a period of three months. The natural variations among the subjects in eating yeast cakes and in chewing prevented a correlation between results of the tests and conditions of oral health. It is therefore unnecessary to give a complete description of the oral health of each subject. A brief general description is given in Table 1.

EVALUATION OF THE EXPERIMENTAL METHOD

The samples were collected two hours after the yeast cakes were eaten because: 1. Early preliminary tests indicated that the results of daily determination of yeast per cubic centimeter of saliva were more consistent if the samples were collected from one to two hours after inoculation instead of earlier. 2. The difficulty of controlling the dietary habits of the subjects prevented significant determinations after longer periods.

Yeast cakes (Fleischman's) were chosen as an indicator because: 1. The yeast was non-pathogenic. 2. The yeast organisms neither reproduced nor were they killed in the salivary suspensions during the few hours necessary for the tests. 3. Yeast colonies were easily cultured on Sabouraud's agar medium, which excluded the great majority of normal oral bacteria. 4. Massive amounts of organisms were necessary in order to have significant comparative determinations after two hours. People in general are less apprehensive about the inoculation of yeast than the inoculation of laboratory cultures of micro-organisms.

The method of plating the samples used was selected because surface yeast colonies could be identified with less difficulty than deep colonies in poured plates. Five of the ten subjects harbored a monilial strain in the normal flora, which was included in the yeast count. The presence of these organisms did not interfere markedly with results because: 1. Results of all tests were compared with control tests on the same individual. 2. The numbers per cubic centimeter of monilial strains in preliminary samples were never more than from 0.5 to 1 per cent of the control counts.

Within certain limits, the method affords significant comparative figures, if even suspensions are possible. This

TABLE 3.—REDUCTION OF YEAST CELLS DUE TO VARIOUS CLEANSING AGENTS. (FIGURES REPRESENT PERCENTAGE REDUCTION PER CUBIC CENTIMETER OF SALIVA BASED ON CONTROL COUNTS)

Subject	Control Average Cubic Centimeter	Percentage Reduction Due to Use of Cleansing Agent							
		Apple	Paraffin	Orange (Sliced)	Chewy Candy	Chewing Gum	Banana	Tooth Brush	Orange (Spoon)
E.P.	2,294,000	96.2	95.5	94.9	95.0	88.4	62.9	42.8	47.7
H.J.	4,730,000	99.1	95.9	97.1	94.0	89.7	89.8	62.3	
H.K.	360,000	97.4	98.7	95.2	89.9	84.4	64.7	80.9	66.0
L.K.	345,000	97.3	97.9	92.8		60.7		60.9	
J.O.	1,190,000	93.0	85.6			85.3		81.6	
E.L.	647,000	96.8	99.1			96.6		78.4	
A.H.	517,000	96.3	84.9			81.3		42.0	
G.D.	397,000	95.5	96.1			64.0		64.7	
G.V.	3,130,000	98.8	99.1			86.8		68.9	
P.R.	2,596,000	94.3	94.8			85.1		57.5	
Average		96.5	94.8	95.0	93.0	82.2	72.5	64.0	56.9

assumption is based on the results of counts made by plating suspensions of weighed amounts of yeast from ten different yeast cakes.

Sixteen 0.1 gm. samples of ten yeast cakes were suspended in 9.9 cc. amounts of 0.85 sodium chloride and the suspensions were further diluted so that each cubic centimeter of the saline solution contained 10^{-7} parts of a gram of yeast. One-tenth cubic centimeter amounts of these dilutions were seeded on forty-eight Sabouraud agar plates as previously described. The result of the counts made from individual plates varied from 173 to 110, with a median of 138 and an average of 139. If average counts from each series of three plates were used, the figures varied from 156 to 125, with a median of 137.8 and average of 137.9.

Eighteen plates were streaked similarly with 1:5,000,000 dilutions of six of the samples and gave comparable results. Earlier experiments indicated the necessity of using separate pipes for each dilution. It was also necessary to use plates free from water of condensation.

From the preceding experiment, it appears that, if even suspensions were possible, colony counts of properly seeded plates of the same dilution should not vary more than 50 per cent. Furthermore, unless plates were either overcrowded or too sparsely seeded, the average of a series of plates from one dilution should be comparable to that of any other dilution. Therefore, in case of counts made from the saliva samples, results were not recorded unless: 1. Plates contained from fifty to 500 colonies. 2. The low count was within 50 per cent of the high for plates of the same dilution. 3. The low estimation made from the average of a series of plates for one dilution was within 50 per cent of the high estimation of another dilution.

It is believed that the results of the experiments offer interesting information when interpreted with a full appreciation of the limitation of the methods employed. A reduction from control counts up to 50 per cent could not be considered of more than doubtful significance, but reductions of from 80 to 100 per cent are probably significant.

RESULTS

The results are recorded in Tables 2 and 3.

Table 2 contains high, low and average counts per cubic centimeter for each series of tests from one representative case. This table is included to illustrate the variations in daily counts and also the method used to determine percentage reductions.

Table 3 is a condensed tabulation of the entire series, including a comparison of the average of each series of tests with the corresponding control average. The comparisons are expressed in percentage of reduction based on the control count.

COMMENT

It is realized that tests of this type offer only limited information and that no direct interpretation relative to oral diseases can be made from the results. However, interesting observations can be made relative to the value of different agents as aids to the natural cleansing mechanism of the mouth.

There was a variation in the ability of different persons to remove loose particles by similar cleansing methods. The individual variations could not be correlated with conditions of oral hygiene. It is of interest to note that the variation was less pronounced with apples than it was with a thirty-minute chewing of gum or paraffin. The individual variation noted in the results obtained with the toothbrush was to be expected since each subject used his own method of brushing the teeth.

The relatively poor showing in the tests employing the toothbrush followed

by the tap water mouth rinse may be due to the following conditions:

1. The results were based on the removal of minute loose particles scattered over the entire mouth.

2. The toothbrush was used only on the teeth and gingival areas.

3. The tap water rinse was not so effective in removing the massive numbers of loose particles as were substances requiring chewing.

One other interesting observation is also suggested; namely, agents encouraging salivary flow and subsequent swallowing may aid the natural cleansing mechanism more than agents depending on expectoration.

The effects exerted by eating a soft food, such as ripe bananas, might possibly be due to adsorption of yeast cells on the food with subsequent swallowing. The greater relative effectiveness of chewing more fibrous foods is demonstrated in the tests with apples and sliced oranges as compared with eating oranges, with a spoon or eating bananas.

The fact that eating the "chewy" candy bar was about as effective as any other method is not contradictory. The material required chewing, made contact with a large percentage of the surfaces of the mouth and was soluble enough to permit even dilutions of samples one hour after it was consumed. These results stress an important fact; namely, that the mere ability of a substance to rid the mouth of already existing particles is not sufficient evidence to justify its use. If, for instance, we accept evidence so often presented that the presence of sugars is a factor in dental caries, undoubtedly the harmful effects from eating substances with a high sugar content may outweigh any beneficial effects from the cleansing action of already existing particles.

The cleansing effect of the paraffin and chewing gum may be due to the mechanical effect of friction and to increased salivation and swallowing. The greater relative effect of chewing paraffin over chewing gum was undoubtedly due to difference in bulk. The chewing gum weighed approximately 3.2 gm. at the start, but, after a few minutes of chewing, weighed only about 0.8 gm., whereas the weight of the paraffin (2.5 gm.) remained virtually unchanged.

The results of these tests agree with views of Wallace (1929) that chewing does materially aid in cleansing the mouth. On the other hand, the results indicate that the immediate complete elimination of large numbers of loose particles is extremely difficult.

SUMMARY

No correlation between results and conditions of oral hygiene was possible in these tests.

The results do not afford any direct information relative to oral diseases.

According to these tests, the chewing of apples, sliced oranges and paraffin aided the natural cleansing mechanism to a greater degree than did the use of other substances tested.

Any possible harmful effects of a given substance must be weighed against its beneficial, cleansing effect.

The relatively poor showing of the toothbrush in these tests may be due to the fact that the removal of loose particles from the entire mouth was considered.

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ACTION OF OXYGEN ON CHRONICALLY INFLAMED GINGIVAL TISSUE

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OXYGEN was introduced in the treatment of gingival inflammation by W. F. Dunlop, who used a specially medicated oxygen which was carried from the oxygen tank through a pressure reducing valve to the gingival tissues. With approximately from 20 to 30 pounds of pressure, the gas was carried through a cannula into the gingival pocket and thence penetrated the subepithelial connective tissue. Oxygen bubbles were observed in the pericapillary lymph and tissue spaces, some distance from the place of application. At different times, this method of oxygen application has been widely used, and many clinicians and research men have found it valuable in the treatment of periodontal conditions.

Oxygen in the form of hydrogen peroxide is widely used as a mouthwash in different forms of gingivitis and is generally favored in ulcerative gingivitis (trench mouth; Vincent's infection). When peroxide comes in contact with tissues, oxygen is liberated owing to the action of an enzyme catalase, which is present in all tissue fluids.

Recently, a new method of application was reported whereby action of the oxygen was prolonged. Here, zinc peroxide is used, a white powder, slowly liberating oxygen as it comes in contact with water or tissue fluids.

All previous authors have attributed the favorable action of oxygen on chronically inflamed gingival tissues to the fact that, in chronically inflamed tissue, there is impaired circulation and a lack of oxygen. It was presumed that the artificial introduction of oxygen causes hyperemia and promotes the circulation, thereby furthering oxidation.

The aim of the present investigation is to ascertain the action of oxygen and to determine the tissue changes which occur after its application.

METHOD OF OXYGEN APPLICATION

To investigate the action of oxygen on chronically inflamed gingival tissues, concentrated hydrogen peroxide, 30 per cent superoxol (Merck), was used.

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Whereas, in Dunlop's method, the oxygen is derived from an oxygen tank as molecular oxygen, the oxygen developed from hydrogen peroxide is a nascent atomic oxygen. The first attempts at using superoxol were made with great care, owing to the warning on the label of the bottle: "Attacks the skin." However, it was soon found that the application of superoxol to the gingivae caused considerably less discomfort than its application to the skin. An unpleasant burning sensation of the skin is experienced, whereas there is only a slight burning sensation of the gingiva.

The pH concentration of superoxol is 1.5 to 2.5 in individual bottles, this considerable acidity being necessary to stabilize the solution. In some cases, slight necrosis of the tip of the gingival papillae was observed, and this was attributed to the acidity. Subsequently, a 5 per cent solution of sodium bicarbonate was used to neutralize the acidity of superoxol. One drop of the 5 per cent sodium bicarbonate solution added to from 5 to 10 drops of superoxol changed the pH concentration of superoxol to between 5 and 6. This neutralized superoxol remains usable for at least thirty minutes, after that becoming decomposed. It should always be mixed just before use. No harmful effect of any kind was observed after repeated use of neutralized superoxol.

Cotton fibers were saturated with neutralized superoxol and, with the aid of a spatula, were carried into the gingival pocket. Owing to the presence of the enzyme catalase in the saliva and pocket content, oxygen develops instantly from the superoxol with considerable foaming. The superoxol is applied for from ten to twenty seconds. The cotton is then removed and the mouth rinsed with a stream of water. Superoxol is applied several times at each sitting, the cotton being left in the gingival pocket for a few seconds each time.

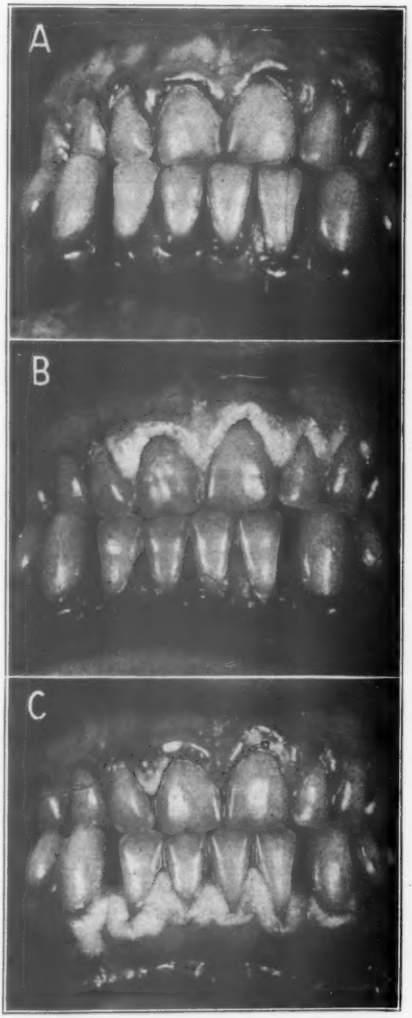

Fig. 1.—Chronic gingivitis. A, before treatment. B, immediately after application of superoxol on upper gingivae; showing blanching of tissues. C, blanching of gingivae in lower jaw after application of superoxol. Blanching has subsided in the upper jaw.

IMMEDIATE ACTION OF SUPEROXOL

The gingiva becomes blanched in one or more applications. The blanching appears abruptly if the gingiva is swollen,

soft and puffy. Often, the gingiva blanches when merely touched with superoxol. In other cases, with a firmer gingiva, the blanching is gradual. In Figure 1A, a case is shown before the application of oxygen; in Figure 1B and C, immediately after the application. The whiteness of the tissue disappears after from ten to thirty minutes. Clinically, the penetration of oxygen deep in the soft tissues, even into the lip, where the presence of the gas is evidenced in an emphysema, can be observed.

After a certain time, sometimes two or three minutes, at other times from ten to fifteen minutes, the oxygen begins to disappear from the tissue. The blanching of the gingivae gradually subsides. Just as some cases show a difference in time of absorption of the oxygen, so is there a difference in time of disappearance of the effects of the oxygen. If it is absorbed readily, it leaves the tissues in a shorter time and *vice versa*. Figure 2 shows the microscopic picture of the gingiva immediately after blanching due to the action of superoxol. The oxygen penetrates the epithelium and passes into the underlying connective tissue, with formation of innumerable bubbles. There are microscopically small bubbles and larger round spaces. Usually, the bubbles are smaller close to the epithelium and larger in the deeper regions. However, there are some larger bubbles in the outer layer and smaller ones in the deeper layers. No bubbles are seen in the cells or in the blood vessels: they are always located intercellularly and in the tissue spaces. Some of the oxygen may be in the lymph spaces and vessels, but whether this is true has not been definitely determined. No capillaries filled with blood are traced where oxygen bubbles are present in large numbers. The capillaries are so completely compressed that even a single red blood cell is rarely found.

Even after repeated application of superoxol, the tissues do not slough. Their blanching is not due to coagulation and necrosis, as is the case in the application of astringent or caustic drugs, such as phenol, silver nitrate, zinc chloride or trichloracetic acid, but is due to pressure of the oxygen that penetrated the tissue and to complete compression of the subepithelial capillaries. As the oxygen penetrates the tissue spaces, the naturally transparent tissues become opaque just as fine air bubbles in suspension lend to water a milky appearance. When the oxygen has left the tissues, the tissue

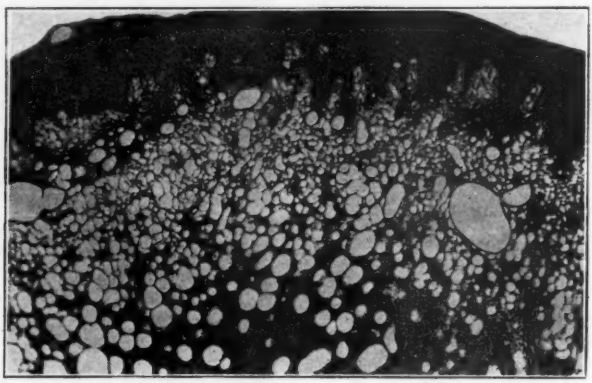

Fig. 2.—Microscopic specimen of gingiva after blanching with superoxol. Oxygen bubbles penetrate deeply the subepithelial connective tissue.

structure returns to normal. The oxygen is probably absorbed by the tissue fluids in a solution, and some part is probably absorbed by the hemoglobin. It is certain that most of it is carried off by the lymph stream. Some oxygen may also be taken up by cellular elements of the inflammatory reaction, and doubtless some of it escapes into the air.

peated two or three times weekly over a period of from three to eleven weeks, on several patients. The following description of the microscopic specimen from one of these cases serves to illustrate the tissue changes which take place on repeated application of oxygen. In Figure 3A, the thoroughly infiltrated gingiva is shown before the application of super-

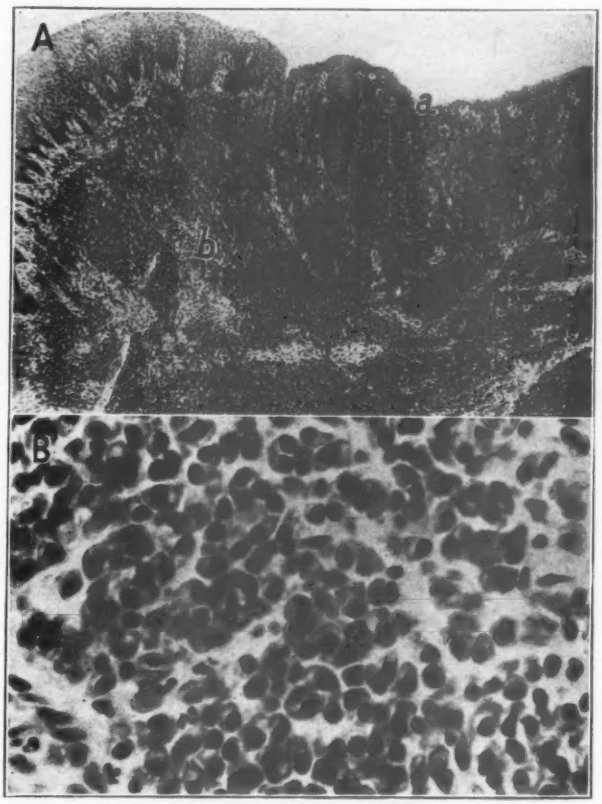

Fig. 3.—A, gingival specimen with chronic gingivitis. The epithelium (a) is irregular and broken. The connective tissue is densely infiltrated by plasma cells (b). B, high magnification of plasma cells.

TISSUE CHANGES AFTER REPEATED APPLICATION OF SUPEROXOL

In order to investigate possible tissue reactions to the application of oxygen, the treatment with superoxol was re-

oxol. The epithelium is broken in several places and the capillaries of the connective tissue reach almost to the surface. The epithelial pegs are very irregular and, in several areas, densely

infiltrated by leukocytes. The connective tissue is almost completely replaced by masses of plasma cells. (Fig. 3, B.) Only a few connective tissue cells and fibers are seen, following some blood vessels. A pathologist may identify this condition as plasmoma. However, it is not neoplasm, but an inflammatory cell accumulation. After seven weeks of application of superoxol, the tissue character changed remarkably. The change was observed clinically also. The formerly swollen, bluish red gingival papillae and margin were a brighter pink and the swelling had subsided completely. The papillae and gingival margin had shrunk and the gingival pockets had almost disappeared. The microscopic specimen (Fig. 4, A.) shows that the epithelium had proliferated, forming irregular pegs which penetrated deeply the connective tissue. Large numbers of mitotic figures are

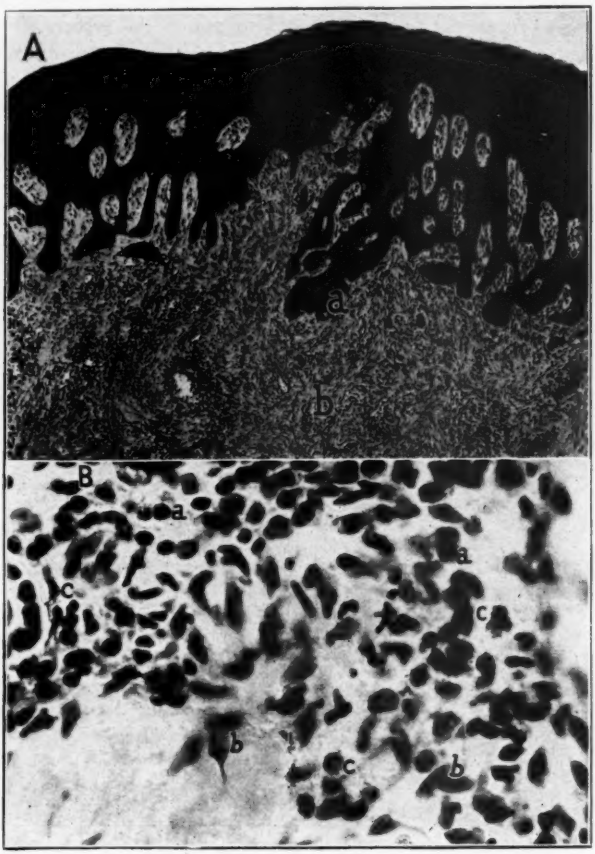

Fig. 4.—A, gingival specimen after seven weeks of applying superoxol (same patient as in Fig. 3, A). There is epithelial proliferation (a) with irregular pegs. The connective tissue (b) has lost the massive accumulation of plasma cells and is rich in capillaries and active mesenchymal elements. B, high magnification of connective tissue; few plasma cells (a); numerous fibroblasts (b), and some eosinophile leukocytes (c).

visible in the epithelium and hornification is also more pronounced than before treatment.

The mass of plasma cells has disappeared completely. The tissue is still cellular, but the cells are not massed in groups as were the plasma cells in the previous specimen. A high magnification (Fig. 4, B.) reveals that only few plasma cells are present and these are in a stage of degeneration. Numerous eosinophile leukocytes are present in this specimen. Their significance is not established, but they probably express some allergic reaction, due to protein decomposition. In this specimen, the presence of the eosinophile leukocytes might be explained as the result of decomposition of plasma cells. Fibroblasts are present in great abundance.

Figure 5 shows an epithelial peg that had been exposed repeatedly to the action of superoxol. About twenty-five mitotic figures can be counted in this one microscopic field. This enormous increase in mitotic activity is characteristic of oxygen.

In order to compare the tissue changes resulting from the action of superoxol with the changes occurring within the same time as a result of scaling and massage of the gingivae, gingival tissue which had not been acted on by superoxol was removed at the same time as the specimen shown in Figure 4. The scaling was performed seven weeks before removal of the specimen and the patient was instructed in massage of the tissues. The microscopic specimen (Fig. 6) shows some improvement as compared to the original section before scaling, Fig. 3, A), but there are still large masses of plasma cells grouped in the subepithelial connective tissue. The epithelium is thicker than was shown previously and some pegs are also present, but no abundant proliferation can be observed such as resulted from the action of superoxol. Mitotic figures are not more numerous than is usual in gingival epithelium.

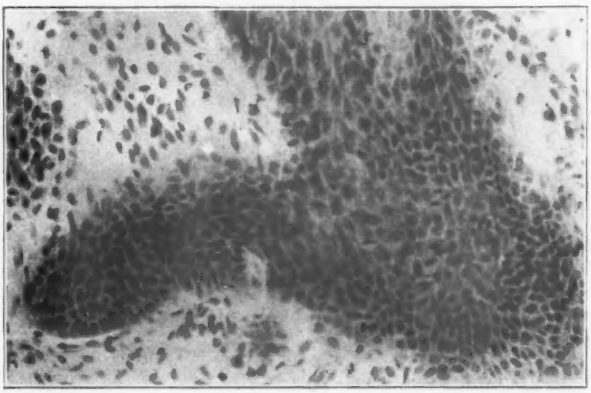

Fig. 5.—Epithelial peg exposed to repeated superoxol action; numerous mitotic figures in different stages.

COMMENT

In chronically inflamed connective tissue, the massive accumulation of plasma cells is the most characteristic finding. This accumulation of plasma cells diminishes successively under the action of superoxol. The reason for this is not known and can be considered only theoretically; nor is the function of the plasma cells definitely known as yet.

They probably develop from the lymphocytes and doubtless have some function in preventing the penetration of toxins from the surface into the deeper tissues.

Unna, who made an extensive study of the chemistry of the skin, states that plasma cells are oxygen carriers. They appear where oxygen is needed. Unna supported his theory by histochemical reactions. However, his assumptions have not been generally accepted.

Menkin asserts that lymphocytic elements appear in the tissues wherever the pH concentration of tissue fluids becomes acid. The acidity of chronically inflamed tissues is due to accumulation of organic acids, mainly lactic acid, as a result of faulty oxidation of carbohydrates. It can be assumed that the plasma cells diminish under the action of superoxol because of increased oxidation of the tissues. This may be the direct action of the introduced oxygen in a nascent state. It may also be indirectly due to increased circulation. The accelerated formation of fibroblasts can also be the result of increased oxidation of the connective tissue, similar to that in the epithelium.

The sequence of events may be as follows: Because of the introduction of nascent oxygen, the local oxidation process is accelerated, owing partly to direct action of the oxygen and partly to an increase in circulation. With the change in local oxidation, the acidity of the inflammatory area is reduced, and thus the lymphocytic elements (plasma cells) degenerate. The entire character of the inflammatory reaction is changed. Eosinophile leukocytes appear, probably as a sign of an allergic reaction, due to local protein decomposition (degeneration of plasma cells). As a result of increased oxidation, fibroblasts develop and the tissue becomes more fibrous. The epithelium proliferates and thickens. The hornification on the surface increases. The greater mitotic activity is probably due to increased oxidation in the tissues. Experiments have revealed (Popoff) that increased oxidation accompanies greater mitotic activity.

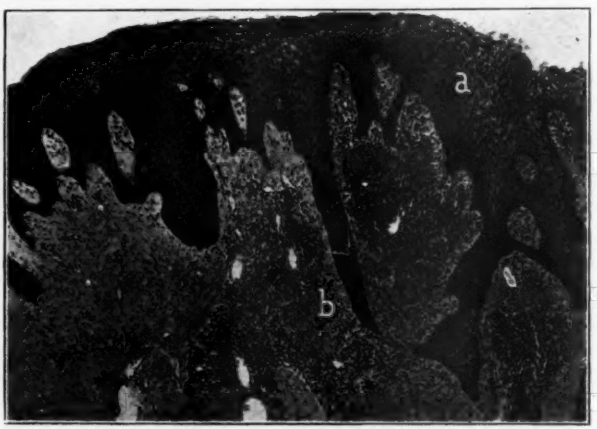

Fig. 6.—Microscopic specimen from case shown in Figures 3 and 4; scaling and massage, but no superoxol applications. a, epithelium thickened, as compared to that in Figure 3. b, connective tissue still densely infiltrated by plasma cells.

SUMMARY

After from three to six weeks of application of superoxol twice weekly, significant changes occur in the epithe-

lium and in the connective tissue of chronically inflamed gingival tissue. In the epithelium, the basal cell layer becomes considerably thicker, frequently forming from four to six layers of cells, and there is a remarkable increase in mitosis. Owing to the increase in mitotic activity, the epithelium proliferates, forming irregular pegs which penetrate deeply the underlying mesenchymal tissue. On the surface, an intensified hornification can be observed.

The repeated application of superoxol causes considerable proliferation in the connective tissue and a change in character of the inflammatory reaction. In the course of this change, the number of plasma cells is reduced and new fibroblasts and capillaries develop. This development of new tissue brings about a complete change in the formerly chronically inflamed, inactive tissue, rendering it capable of active tissue reaction, mainly in the direction of tissue regeneration. These facts place oxygen in the arsenal of active remedies as an agent in the treatment of chronically inflamed gingival tissue.

The application of the neutralized superoxol, as described herein, also resulted successfully in the treatment of acute and chronic ulcerative gingivitis. It was also found useful in rendering the gingival margin dry before placing a filling or a crown. The blanching of the gingival margin disappears after a certain time, without loss of tissue; whereas, if a caustic is used, sloughing occurs.

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DIAGNOSIS AND TREATMENT OF DISEASES OF THE SALIVARY GLANDS

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BEFORE actually entering into a discussion of the subject, let me make it clear that I do not propose to consider every possible condition of the salivary glands or to discuss the treatment of any condition not within the province of the dental surgeon. From the dental viewpoint, the diagnosis of tumors of the salivary glands is of vital importance, yet it is scarcely within the province of the dental surgeon to render the extensive surgical treatment that such a condition may require.

While neither time nor space will permit as complete a discussion as might be desirable, it is important to consider briefly salient features of the anatomy and physiology of the glands. It is upon a complete understanding of these fundamentals that the treatment is sometimes based.

ANATOMY

There are, as we all know, three pairs of salivary glands, which secrete their products into the oral cavity. (Fig. 1.) It is estimated that they secrete from 2 to 3 pints daily (946 to 1,419 cc.). These glands are the parotid, the submaxillary and the sublingual. The parotid gland, the largest gland of all, weighs from 14 to 28 gm. It is found within the cheek, below and in front of the external ear. The gland is enclosed in a capsule continuous with the deep cervical fascia. The major portion of the gland, which is superficial, is roughly quadrilateral and flattened, and it occupies the space bounded by the ramus of the mandible, the mastoid process of the temporal bone and the sternocleidomastoid muscle. The gland extends upward almost to the zygomatic arch, occasionally passing beneath the arch. Below, the gland usually does not extend lower than the angle of the mandible. A part of the gland "cups" the posterior border of the ascending ramus and lies upon its medial surface.

The external carotid artery lies on the medial surface of the gland and passes into the substance of the gland, giving off the posterior auricular branch which makes its exit from the posterior portion of the gland, dividing into external branches, the internal maxillary and the superficial temporal. The internal maxillary artery passes forward medially to the neck of the mandible, while the superficial temporal artery runs across the zygomatic arch and gives origin to the transverse facial branch which makes its exit from the anterior part of the gland.

Above the artery are the veins, the superficial temporal and the internal maxillary, which unite to form the posterior facial vein. At the lower part of the gland, this vein divides into two parts, the anterior and the posterior. The anterior makes its exit from the gland and combines with the anterior facial vein to form the common facial, while the posterior joins within the gland with the posterior auricular, forming the external jugular. Above the vessels is the facial nerve, the branches of this nerve emerging from the borders of the gland. The branches of the greater auricular nerve pierce the gland and combine with the facial. The auriculo-

temporal nerve emerges from the upper part of the gland.

The duct of the parotid gland, known as Stensen's duct, is a thick-walled tubular structure approximately 5 to 7 cm. long. It commences at the anterior portion of the gland and is made up of numerous branches. As it crosses the masseter muscle, it receives the duct from the accessory lobe of the parotid gland when this lobe is present. At the anterior border of the masseter, the duct turns sharply, almost at a 90-degree angle, and passes through the fat of the cheek and through the buccinator muscle. The duct then runs obliquely forward between the buccinator and the oral mucosa and opens inside the cheek opposite the upper second molar tooth.

The arteries which supply the gland are derived from the external carotid artery. The veins have already been described. The lymphatics arise from the superficial and deep cervical glands, passing through nodes within the substance on the surface of the gland. The innerva-

DIFFERENTIAL DIAGNOSIS OF MORE COMMON DISEASES OF THE SALIVARY GLANDS

Disease	Nature and Location of Lesion; Frequency	Age	Duration	Constitutional Symptoms	Pain	X-ray Findings
Calculus	1. Submaxillary 2. Parotid 3. Sublingual	Any age, Usually midlife	Many years duration	Unusual, may have low temperature	Recurrent characteristic salivary colic	Presence of calculus
Parotitis (non-suppurative)	1. Parotid	Early middle life	Recurrent attacks of long duration with onset scarcely noticeable	Mild, if any	Fullness, discomfort, usually mild	Scattered "buckshot" destruction of secreting portion of gland
Parotitis (suppurative)	1. Parotid; may be bilateral	Any age	Sudden, following operations or infections about the mouth	Usually severe, toxic	Continuous, severe	Extensive destruction of secreting part of gland
Endemic parotitis	Usually bilateral	Children, occasionally adults	5-7 days	Malaise, moderate temperature, vomiting, possibly orchitis or mastitis	Moderate to severe	
Tumor	Frequency: 1. Parotid region 2. Submaxillary 3. Sublingual Unilateral hard nodule	May occur in children but usually in midlife (20-40 years)	Long	Usually none unless it breaks through the gland capsule or metastasizes	Not in early stages	Obliteration of arborization

tion is from the sympathetic plexus on the external carotid artery, facial, auriculotemporal and the great auricular nerves.

The duct must not be regarded as a straight tube, since it pursues a somewhat undulating course to permit the flexibility required by the movements of the cheek. (Fig. 14.)

On the surface, the anterior border extends forward over the masseter muscle. The posterior part of the gland is limited by the tragus, the mastoid process and the anterior border of the sternocleidomastoid muscle. The lower border is indicated by a line from the tip of the mastoid process to the greater cornu of the hyoid bone. The upper portion is represented by the posterior two-thirds of the zygomatic arch. On the surface, the duct could be indicated by a line drawn from the tragus to a point midway between the angle of the mouth and the ala of the nose. The duct does not, of course, extend along the entire length of this line.

The submaxillary gland, which is encapsulated, is intermediate in size between the parotid and the sublingual. It is somewhat irregular in shape and roughly about the size of a walnut. The major part of the gland is within the submaxillary triangle. It extends from the stylomandibular ligament, which separates it from the parotid gland, forward to about the anterior belly of the digastric muscle. Below, it overlaps the intermediate tendon of the digastric muscle and the insertion of the stylohyoid; above, it lies under cover of the inner surface of the body of the mandible. An extension of the gland passes from the deep surface forward and above the mylohyoid muscle.

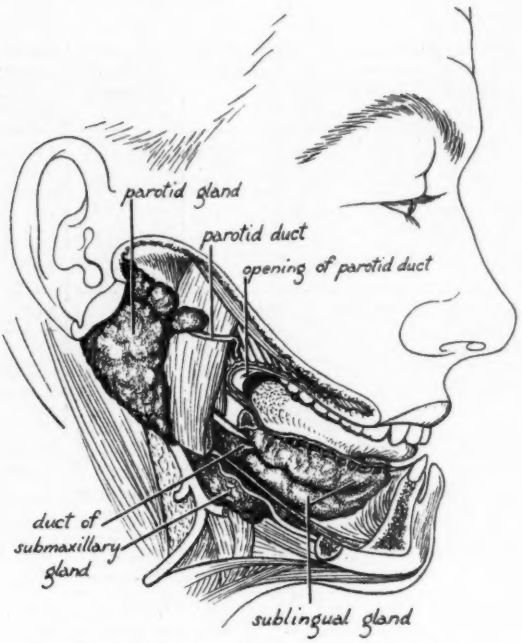

Fig. 1.—Normal anatomy of salivary glands.

The submaxillary duct, known as Wharton's duct, is about 5 cm. long. It is thinner-walled than the parotid duct, and begins as numerous branches from the deep surface of the gland, passes forward between the mylohyoid, hyoglossus and genioglossus muscles, and, at the side of the frenum of the tongue, it opens into the mouth through a small orifice at the summit of a small papilla on the plica sublingualis. On the hyoglossus, it lies between the lingual and the hypoglossal nerve. At the anterior border of the muscle, the lingual nerve crosses it laterally, and terminal branches of this nerve ascend on the medial side. The blood supply of the gland is from branches of the external maxillary and the lingual arteries. The veins parallel the arteries. Innervation is from the submaxillary ganglia, through which come filaments of the chorda tympani of the facial nerve and the lingual branch of the mandibular nerve; occasionally from the mylohyoid branch of the inferior alveolar nerve, and from the sympathetic nerves.

The sublingual gland is the smallest salivary gland. It is somewhat almond-shaped and has no capsule. It is located on the floor of the mouth, and there is one on each side of the frenum of the tongue, beneath the oral mucosa. The gland fits into a depression on the inner surface of the mandible. Below, the gland is in contact with the mylohyoid muscle; behind, with the deep portion of the submaxillary gland; laterally with the inner surface of the mandible, and medially with the genioglossus. The lingual nerve and the submaxillary duct intervene between the muscle and the gland. Occasionally, some of the smaller sublingual ducts join the submaxillary duct, or they may open independently on the crest of the plica sublingualis.

Fig. 2.—Characteristic parotid swelling; showing flattened cone-shape, with greatest height about level of lobe of ear. The swelling extends to below the lower border of the mandible. (Compare Fig. 3.)

Fig. 3.—Osteomyelitis of mandible. The swelling is entirely different from that shown in Figure 2.

The blood supply is furnished by the sublingual and submental arteries. The nerves are the sympathetic, chorda tympani and lingual.

HISTOLOGY

The salivary glands are compound tubulo-alveolar glands. The parotid gland has chiefly serous alveoli, while the submaxillary and the sublingual have both serous and mucous alveoli. Thus, they are known as mixed glands, while the parotid is known as a purely serous gland.

The glandular tissue itself is made up of the parenchyma and a supporting

Fig. 4.—Swelling of submaxillary gland during an attack of salivary colic. (Compare Fig. 5.)

connective tissue, the interstitial tissue or stroma. As mentioned previously, the parotid and submaxillary glands are enclosed within a distinct connective tissue capsule, while the sublingual has no real capsule. Connective tissue septa divide the gland into lobes, and these in turn into lobules. The larger ducts, blood vessels and ganglion cells are found within the septa.

The gland itself is made up of branching ducts which communicate with the terminal secreting alveoli. The ducts that begin within the lobule are known as intralobular ducts. Uniting, these run between the lobules and are then known as the minor or interlobular ducts. These in turn unite, becoming larger in caliber, and are called major or interlobar ducts, which finally join to form the main duct of the gland. The smaller intralobular ducts are lined with secretory cells and, in some measure, it is believed, actually contribute to the secretion. In the two larger glands, the parotid and the sub-

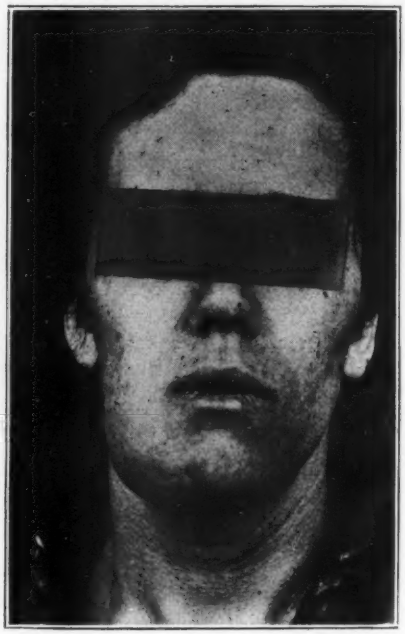

Fig. 5.—Tumor of mandible.

maxillary, these actual "salivary" ducts open into tubules having a flat epithelial lining. These tubules, lying between the salivary ducts and the terminal alveoli, are known as the intermediate tubules or intercalated ducts. The serous alveoli have a lining which consists of pyramidal epithelial cells resting upon a basement membrane and surrounding a narrow lumen.

Histologically, the appearance of the cell varies according to the state of its activity. In a resting stage, the cytoplasm appears to be filled with a number of small highly refractive granules. These occupy the distal part of the cell and, as they increase in number, the nucleus is pushed to the base of the cell. The cell itself becomes engorged and the lumen of the alveolus decreases in size. A decrease in the number of granules follows active secretion, and they gradually occupy a more proximal position within the cell, toward the lumen. Basal or basket cells, peculiar stellate cells, are found between the secreting cells and the basement membrane. They are considered as supporting cells the function of which is to aid in the discharge of the secretion by contraction. In the mucuous alveoli, the mucous cells are quite distinct and they too rest upon a basement membrane. In a resting stage, the deeply stained nucleus is flattened against the base with a slight amount of cytoplasm above. A coarse basophilic network occupies the remainder of the cell, with the precipitated material of the secretion granules. These granules, or mucinogen droplets, occupy the spaces of the network. As the cell discharges its secretion, the droplets decrease in number, the nucleus becoming spherical or oval and its chomatin network becoming more distinct.

In the mixed type of gland, there are several types of terminal alveoli, some being composed entirely of serous cells, others entirely of mucous cells, and still others having both kinds of cells with the serous cells usually located at the distal end of the alveolus and the mucous cells usually found near the exit.

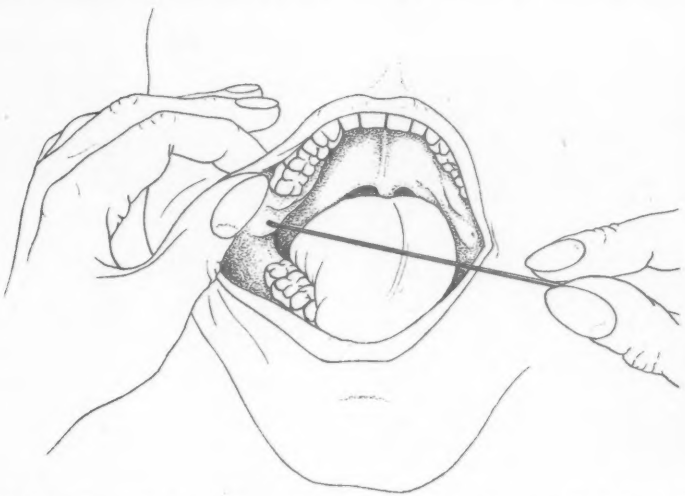

Fig. 6.—Probing Stensen's duct. The probe is introduced almost perpendicularly to the cheek.

PHYSIOLOGY

Saliva is the product of the secretion of all the glands as well as of some of the small mucous glands in the mucous membrane of the mouth. It is a colorless, somewhat cloudy slimy fluid. The reaction in healthy individuals is slightly alkaline; specific gravity 1.002 to 1.008.

The saliva contains a diastatic ferment, ptyalin. The presence of formed elements, desquamated epithelium, disintegrating leukocytes, gland cells and coagulated clumps of mucin accounts for the cloudiness.

These coagulated clumps of mucin are of clinical significance, for they may act as a nucleus upon which the salts of the saliva are precipitated, thus forming a salivary calculus.

The chief function of the saliva is to moisten the food and to facilitate both mastication and deglutition. Mucin is important since it renders the bolus of food slippery. A less important function of the saliva is its diastatic digestive action, and this function is not of much clinical importance for us. After removal of a salivary gland, disturbance of function is rarely noted.

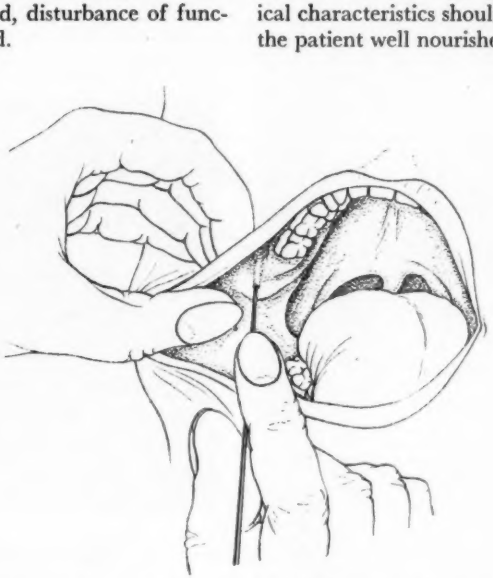

Fig. 7.—Probing Stensen's duct. The fingers of the left hand are stretching the lip and cheek outward and forward, thus straightening the course of the duct. The probe has been moved forward so that its direction will be that of the straightened duct.

EXAMINATION

Dental surgeons are not called upon to conduct a complete general physical examination, but they can obtain much information by simple inspection and history. The history should be carefully taken, and, in many cases, diagnosis can be based upon this alone. The nature of the pain, if any, should be determined. Is it constant or intermittent? Is it present only upon movements of the jaw? Does it bear any relationship to eating, or possibly even to the thought of food? Will acid foods bring on the pain? If the pain is intermittent, how long do the attacks last? Do they increase in intensity? Is the decrease of pain associated with a sudden flow of saliva into the mouth? The answers to these questions, if intelligently interpreted, are of inestimable aid.

A general inspection of the patient should be carried out. The general physical characteristics should be observed. Is the patient well nourished, or emaciated? Has there been any recent loss of weight? Is the color normal or does it indicate secondary anemia? Or is the color high, indicating a possible rise in temperature? Is the patient cachectic? Does the lower jaw move freely and without difficulty, or do the movements seem to cause pain, suggesting pressure on the parotid gland? Is speech affected, perhaps thickened, as might occur when swelling in the floor of

the mouth interferes with the movements of the tongue? The temperature should always be taken.

Examination of the Affected Part—One should always possess a clearcut picture of the normal before attempting to diagnose a pathologic condition. The local examination should be systematic and routine. It should begin with a visual examination, first extra-oral and then intra-oral. The patient should be seated about level with the examiner's eyes, with a good light directly on the face. Any swelling should be carefully observed. The accompanying photographs show swelling about the jaws due to definite conditions. Positions should be carefully fixed in mind. Figure 2 shows the typical swelling of the parotid gland. It is located below, and in front of, the ear and extends downward slightly below the angle of the jaw. Figure 4 shows the swelling of the submaxillary gland. This too presents a characteristic appearance and position. When one has concluded the extra-oral inspection, the intra-oral examination should be undertaken. The general condition of the teeth and the mucous membrane should be observed, as well as the presence or absence of tartar on the teeth. The condition of the ampulla of Stensen's duct, as well as that of Wharton's duct, should be noted. Possible redness, erosion or inflammatory changes may be seen. Sometimes, a drop of modified or purulent saliva is present. The gland and duct should be stripped by gentle stroking from the gland toward the duct.

Fig. 8.—Faulty injection. The operator has not even entered the submaxillary duct. Evidently, the attempt was made to inject Wharton's duct, but the solution has been deposited in the tissues of the floor of the mouth.

Fig. 9.—Two small calculi in Wharton's duct.

Bimanual palpation of the floor of the mouth is absolutely essential. Routinely and carefully carried out, it will provide much useful information. The patient is told to let the lower jaw hang free, and thus relax the muscles of the floor of the mouth. The extra-oral fingers should exert gentle pressure, while the intra-oral fingers carefully examine the floor of the mouth. Swelling, induration, nodules, points of tenderness, etc., should be carefully looked for. The routine procedure should be repeated with the extra-oral fingers carrying out the palpation.

The presence or absence of palpable lymph nodes is of clinical significance. The normal parotid gland is soft, and one hardly realizes where the gland begins or ends. On the other hand, bimanual palpation of the normal submaxillary salivary gland will disclose a smooth, rounded gland of moderate firmness, with no tenderness. A stone can frequently be palpated as a hard, unyielding nodule, tender and often sharply painful to palpation, a "sticking" pain. A non-suppurative inflammation of the gland will be seen as a tense swelling with no induration of the surrounding area. If suppuration is present, the swelling will be accompanied by considerable localized edema. Also, fever and other constitutional symptoms are present. Malignant tumors of the salivary gland are usually (until the later stages) painless, and they are dense, nodular growths.

Fig. 10.—Large calculus at the base of Wharton's duct.

Probing the ducts of the salivary glands is a procedure which should and can be carried out easily and simply with little if any discomfort to the patient. The patient should be seated vertically upright with the head in a headrest or may be placed prone. In either position, the head must be supported. Good light is essential. Let us assume that we are to probe Stensen's duct. The mouth should be open about three-quarters and the cheek near the angle of the mouth should be grasped between the thumb and index finger of the left hand (if the examiner is right-handed), one finger in the mouth and the other on the cheek. (Fig. 6.) The remaining fingers should rest upon the cheek. The papillae should be gently dried with a cotton applicator stick and the extra-oral fingers not grasping the cheek should be used to milk the gland. As the saliva exudes from the orifice, the precise location should be noted. Occasionally, one may encounter some difficulty in locating the orifice. In this event, the papillae should be dried gently with a cotton applicator stick, then painted with a little diluted iodine, and immediately dried with another cotton applicator stick. The location of the orifice is indicated by a tiny ring of mucous membrane stained somewhat darker than the surrounding tissue.

A small flexible probe held in the right hand should be introduced into the duct, starting at almost a right angle. The probe should be highly polished throughout its entire extent, since any roughness will damage the duct lining. The probe should not be forced, but should be permitted to find its way gently and easily. Now, with the probe in place, the left hand stretches the cheek forward and somewhat upward (Fig. 7),

for the purpose of straightening the curvature of the duct as it courses around the anterior border of the masseter muscle. The probe should then be gently pushed backward while the outside fingers follow its course to the gland. When properly carried out, this is an almost painless procedure, and there should be no bleeding or pain. Bleeding indicates that the duct has been perforated.

With an apprehensive patient, even the discomfort of probing the duct can be avoided by instilling a few drops of a topical anesthetic (cocaine 4 per cent, or butyn or pontocaine), using a lachrymal cannula in the manner described for injecting the duct.

In probing Wharton's duct, the same instruments are used, but, in this case, one cannot straighten the duct by digital manipulation, and therefore the following simple method can be used. After the orifice has been located, the patient should be requested to curl the tongue, placing the tip of the tongue upon the roof of the mouth about halfway back. Probing the submaxillary duct is apt to be somewhat more difficult, but can easily be learned by careful practice. Since this duct is smaller, it may be necessary to use a thinner probe. A stylet from a fairly heavy caliber hypodermic needle held in a dental broach holder will sometimes be very useful in effecting an entrance and in determining the course of the duct. It must be remembered that the oral end of the duct is superficial, in contrast to the mucosa of the floor of the mouth.

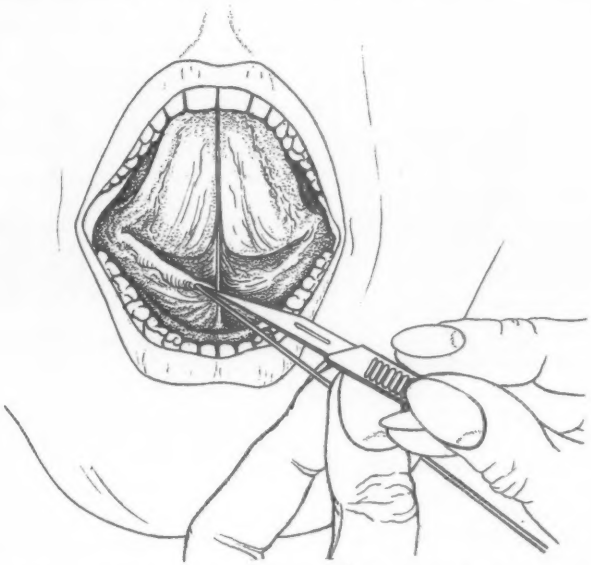

Fig. 11.—Meatotomy of Wharton's duct. The end of the probe should be in contact with the stone. The back of the knife is in contact with the probe, and the duct should be slit upward, away from the probe.

The presence of calculi in the ducts can almost invariably be detected by probing and by digital examination.

SIALOGRAPHY[1]

The technic of injection is simple and, when properly done, is free from injurious after-effects. A blunt, flexible, thin, silver

cannula; a 5-cubic-centimetre syringe; and a fine, flexible probe with a blunt end are all the instruments necessary.

The lipiodol is first warmed so that it will flow easily. In injecting the parotid duct, the patient is seated with the mouth open, and the operator uses the thumb and index finger of his left hand to retract the cheek. The second and third fingers then press the cheek inward in the region of the papilla. A disclosing solution of some kind, such as 3.5 per cent iodine, is applied to the papilla, and the opening of the duct is revealed. With the operator maintaining his position, the flexible probe is inserted and passed into the duct for a short distance in order to verify its patency. In doing this, extreme care must be taken lest the duct be perforated. The probe is then withdrawn, and the flexible cannula inserted in its place and from 1 to 2½ cubic centimetres of the warmed lipiodol injected slowly. There will be some external swelling

Fig. 12.—Large calculus removed from Stensen's duct.

in the parotid region and some slight discomfort. When pain is felt, the injection should be discontinued.

The exposures should be made immediately. A 23-degree reverse angle board is used and the position is the same as that for a temporo-mandibular joint or the ascending ramus of the mandible. (Figs. 14 to 20.)

In the presence of any active infection, it is not advisable to inject lipiodol on account of the danger of spreading infection.

SALIVARY CALCULUS

Occurrence.—Of all the conditions affecting the salivary glands, calculus is perhaps the most common. The submaxillary gland is the one most frequently affected, the parotid next and the sublingual least of all. It is my belief that salivary calculi are no less common than kidney stones or gallstones. Patients do not seek treatment because of salivary calculi unless they give rise to marked symptoms. We may thus question the statistics on the actual occurrence. On the other hand, because kidney stones and gallstones give rise to such symptoms, clinical investigation is followed by operative interference and their presence is disclosed much more frequently.

Etiology.—Although the precise etiology of the salivary calculus has not been settled beyond question, a reasonable explanation of the mechanism of formation is offered. Often, the theory has been advanced that the stone results from deposition of calcium salts upon small foreign bodies which found their way into the duct. I have never seen a foreign body in the ducts, and I regard this theory of the formation of calculi as one

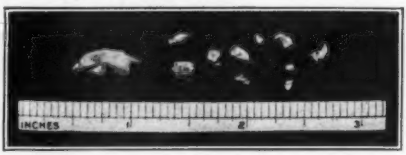

Fig. 13.—Calculus removed in pieces from submaxillary duct. Postoperative x-ray examination should be carried out to make certain that no calcareous particles have been left behind.

which belongs with the other curiosities and rarities that are found in medicine. Salivary calculi are composed of magnesium and calcium phosphate, fluoride and carbonate of calcium, and sodium and potassium chloride and small amounts of potassium sulfocyanide. Tartar found upon the teeth has the same formula. It is significant that the deposition of tartar takes place upon those teeth nearest the openings of the ducts. We may, for our purpose, look upon the saliva as a solution of salts. When the saliva passes from the gland substance itself into the duct and thence into the mouth, its temperature is gradually lowered. This results in the precipitation of

the salts in the saliva upon any available base. In the duct, this available base may be a small plaque of precipitated mucin. Having been formed, the stone usually continues to increase in size, growing by concentric layers.

Frequency.—Calculi may occur at any age, having even been reported in infants. It has been said that the condition occurs principally in middle life. I believe that this is a misconception. It occurs earlier, but may possibly only be detected in middle life.

Clinical Symptoms.—The symptomatology of salivary calculi may be divided into two groups of signs: inflammatory and obstructive. A small stone may give rise to no symptoms whatsoever. On the other hand, it may have a ball-valve action and, through its movements in the duct, fall back and obstruct only one particular lobe. As the stone increases in size, the symptoms may become more pronounced. At the actual site of the stone, the pressure from it may cause ulceration and erosion, followed by fibrosis and subsequent constriction. Even all of this can scarcely be noted by the patient until either the stone itself reaches a certain size or the inflammatory reaction occasioned by the stone begins to bring about the obstructive symptoms. The patient will then complain of a sense of fullness at about meal time, varying from a slight discomfort to pronounced swelling and pain. Sometimes, eating sharp or spicy foods, which may cause a sudden secretion of saliva, will bring about the swelling and with it the pain. This so-called salivary colic is characteristic. The sharp pain and swelling appear suddenly at about mealtime, increase in intensity for a short time and gradually disappear, the pain going first and the swelling lasting a varying length of time, from a few hours to possibly a day or two. Fever is occasionally present. It is usually at this stage that the patient seeks treatment. With this clinical picture, what is actually going on in the duct and the gland itself? Usually, secondary infection ascends via the duct and may in some cases lead to an extensive suppurative process. The repeated attacks of salivary colic at varying intervals may in rare cases result in an

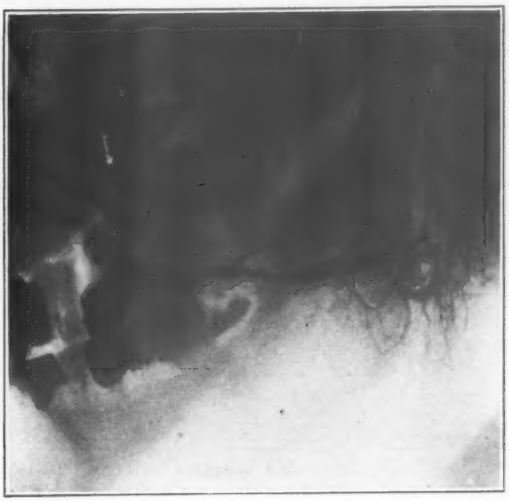

Fig. 14.—Normal injected parotid gland of man; showing branchings of ducts.

ulceration and abscess formation with the stone eroding its way either into the mouth or deeper into the tissues.

PATHOLOGY

When a duct is obstructed and the saliva continues to be secreted, the duct system fills up, and back pressure of the saliva itself results, as well as the pressure of the surrounding tissue upon the gland. Secondary infection develops and destruction of the secreting cells of the alveoli begins to take place. It is possible that with each recurrent attack of salivary colic, only a few alveoli may be affected. These cells are replaced by fibrous tissue, and thus, in many cases, much of the secretory function of the gland may be destroyed. The gland itself becomes hard and dense. Early treatment will usually clear up the infection, but occasionally it is necessary to remove the gland (submaxillary).

Diagnosis.—One can usually make the diagnosis merely on the basis of the history. However, palpation almost invariably discloses the presence of the calculus. Probing will confirm the diagnosis, and the contact of the end of the probe with the stone will elicit a distinct gritty sensation. Too much probing and manipulation should be avoided in the presence of active infection. In addition, it will be noted that the orifice of the duct is somewhat reddened, and quite often a drop of pus or modified saliva can be expressed from the duct. Usually, roentgen examination will reveal the presence of the stone. A horizontal-bite film may be used in the case of the submaxillary gland, with the rays directed from below. (Figs. 8, 9 and 10.) For the parotid gland, an extra-oral plate or one in an oblique lateral position may be used.

Treatment.—The treatment is, of course, surgical, and the stones should be removed with as little damage and surgical trauma as possible. The precise location of the stones should be ascertained roentgenologically. A few drops of a topical anesthetic solution should be instilled into the duct. In the case of the submaxillary gland, a mandibular injection to block the inferior dental nerve should be undertaken. Local infiltration of procaine should, if possible, be avoided for it tends to distend the tissues and will make surgical procedure more difficult. My own preference is to use an

Fig. 15.—Parotid gland two months after pyogenic infection. There is no filling of the secreting portion of the gland, this indicating widespread destruction.

intra-oral route via the duct. A probe is inserted in the duct until it is in contact with the stone. Then a sharp pointed blade (such as No. 11 Bard-Parker) should be used to perform a meatotomy. (Fig. 11.) The back of the blade should rest upon the probe and the cutting should be done from the probe upward for the submaxillary, medially for the parotid gland. The stone should be gently coaxed from its bed, great care being taken to remove it *in toto*. I believe that, in most recurrences, the entire stone has not been removed, or if there were more than one stone, all the stones have not been removed.

Occasionally, one encounters a stone that seems to be firmly embedded in fibrous tissue. A gentle dissection should be carried out and a small spoon curet may be used to lift the stone from its bed. (Figs. 12 and 13.) The stone should be removed without crushing and should never be forced in any way. When a stone is taken out through the duct, no gauze drains of any kind should ever be used. Instead, a small rubber tube drain (size 8 rubber catheter) should be sutured in place with the proximal end of the tube extending to the bed of the stone and the distal end in the mouth, cut across obliquely. This tube will maintain wound drainage and will at the same time permit the saliva to find its way into the mouth, thus avoiding any damming back. The remainder of the incision can be sutured over the rubber tube drain. Three or four days will usually suffice for the drain. Upon its removal, an epithelialized tract will be present of such size that even when contraction takes place, the flow of saliva will not be obstructed.

Fig. 16.—Tumor of parotid gland of twenty years' duration. An operation was performed eighteen years previously, another after this picture was taken. The microscopic diagnosis was endothelioma. The duct system was destroyed and distorted, and the entire area appeared opaque.

Postoperative x-ray examination should be carried out to make certain that no particles of the calculus have been left behind.

EPIDEMIC PAROTITIS (MUMPS)

Epidemic parotitis is a non-suppurative, highly contagious inflammatory disease affecting one or more of the salivary

glands. Usually, the parotid gland is affected on both sides. There may be a complicating orchitis or mastitis. It is a disease which usually, if not always, affects children, and males seem to be more susceptible than females. The cause has not been definitely ascertained, and has been variously assigned to a spirochete, a diplococcus and even a filterable virus. The incubation period is from one to three weeks. The disease begins with either a chill or possibly moderate fever, malaise, headache and, in children, vomiting. The swelling is painful and the patient has difficulty in opening the mouth wide. The swelling increases somewhat rapidly and the pain intensifies. The skin overlying the glands becomes edematous. Occasionally, the other salivary glands are affected, and, in males, an orchitis may develop. Sometimes, when only one gland is affected, the swelling may decrease and, as this occurs, the opposite gland becomes affected. In the usual case, the course lasts from five to seven days. Occasionally, the symptoms described are much aggravated, and it is in these severe cases that complications are apt to occur.

Orchitis is accompanied by a rising temperature or a distinct chill and an acute pain in the testicle. This complication may last from five to seven days.

Treatment.—Aside from mouth hygiene and the usual general supportive measures, epidemic parotitis has no treatment except palliative measures. The use of convalescent serum, if given early, may prevent orchitis.

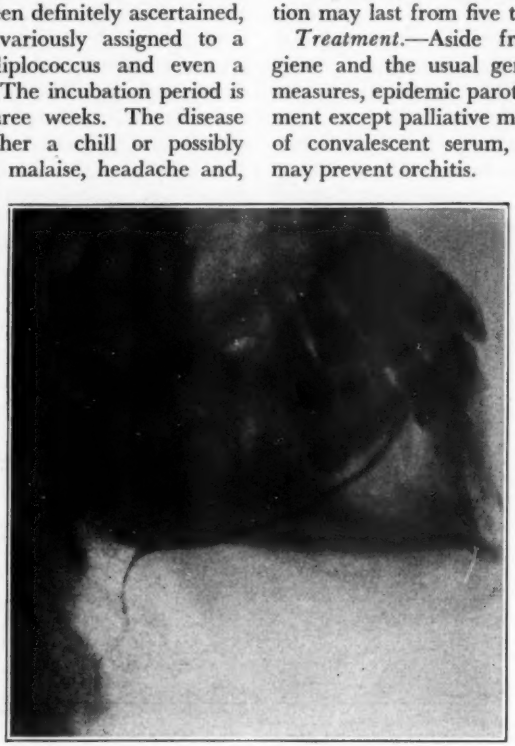

Fig. 17.—Normal injected submaxillary gland.

PAROTITIS

Parotitis (not of the epidemic type) may be divided into suppurative and non-suppurative cases. The non-suppurative type is usually associated with obstruction. It may well be that in both types the obstruction itself is the forerunner and that the accompanying back pressure and swelling provide an excellent basis for bacterial invasion, which utilizes the duct as a portal of entry. On the other hand, the duct lining may first become damaged as a result of primary

infection or trauma, and the swelling of the duct lining obstruct the lumen, with a consequent back pressure and spreading of the original infection to the secreting portion of the gland. The severity of the symptoms depends not only on the virulence of the infection, which in the non-suppurative case is low grade, but also on the completeness of the obstruction. In most cases, the occlusion is not complete, but there is some drainage of a modified saliva into the mouth.

These patients will usually give a history of long duration. The original attack on opening the mouth. These patients will usually not have a high temperature, if any abnormal temperature is noted at all. The disease may continue with these recurrent attacks for a long period of years, and, in other cases, an acute exacerbation may develop into a suppurative parotitis. Recurrent attacks and back pressure lead to destruction of the alveoli and to fibrotic replacement.

In these cases, before suppuration has been noted, a simple treatment can be carried out to relieve the symptoms and, in most cases, cure the stenosis of the

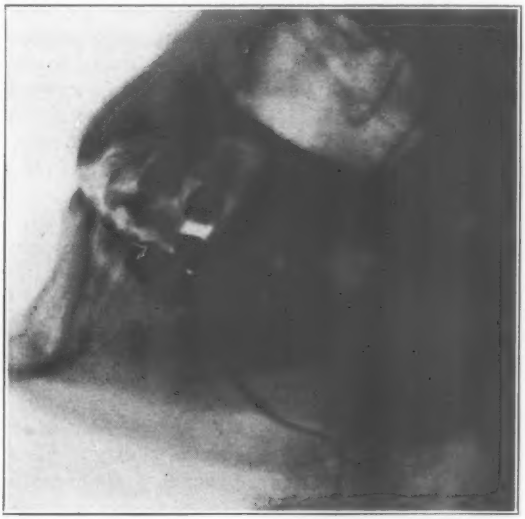

Fig. 18.—Submaxillary tumor of recent origin; showing opacity.

may have been very mild—merely a slight sense of fullness in the cheek. Sometimes, members of the family call the patient's attention to the swelling. The fullness in the cheek may interfere but little with the movements of the cheek, and gradually decrease in size with the emptying of the gland. As the stenosis of the duct increases and with it the back pressure, the recurrent attacks of swelling will become more frequent and the sense of fullness change into tenderness and pain, and discomfort and pain duct. I have noted in several cases, non-suppurative of course, that, after injection of lipiodol, all symptoms disappeared, without recurrence. This is attributed to the antiseptic effect of the iodine content of the lipiodol, as well as to the fact that the actual injection dilated the duct. Progressive dilatation of the duct with filiform rattail bougies will permit the flow of saliva into the mouth, thus preventing back pressure and consequent destruction of the secreting portion of the gland.

A fine rattail filiform bougie is introduced into the duct in the same fashion that the probe is used, as described previously. If difficulty is encountered in inserting the bougie, the duct may be dilated with a few drops of lipiodol, by means of a lachrymal cannula. Through the dilated orifice, the finest rattail filiform bougie is gently inserted, following the course of the duct, and may be passed back for a distance of almost 3 inches. The bougie should be left in place for about five minutes, then removed, and a larger size inserted in its place, and this left for approximately ten minutes. The

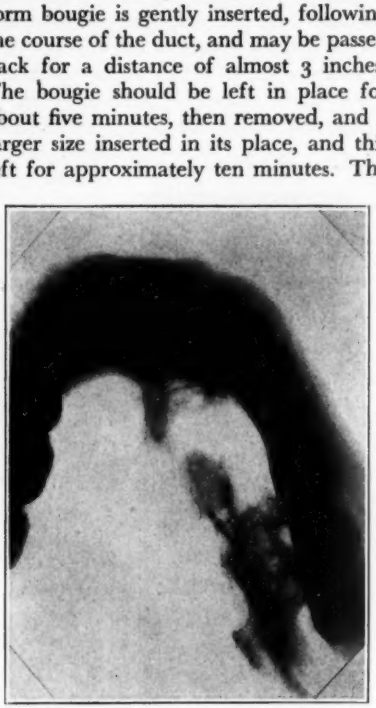

Fig. 19.—Large calculus in Wharton's duct.

bougies should be absolutely smooth. They may be lubricated by dipping the tip into sterile mineral oil. Usually, after the first treatment, the patient will note a distinct improvement. The treatment should be repeated not oftener than twice a week. Once weekly is preferable, and five or six treatments will usually suffice.

In cases of suppurative parotitis, I should hesitate to use this method of treatment unless the constitutional symptoms were slight, and unless, after one dilatation, the drainage from the duct was profuse.

The non-suppurative type may affect the submaxillary gland as well as the parotid, and the treatment is the same.

In non-suppurative parotitis, described above, there are few constitutional symptoms, and the effects are fairly well localized in the gland, although there may be a slight suppuration. This type rarely, if ever, develops into the suppurative parotitis, which is an extremely virulent infection and associated with profound constitutional symptoms.

Pyogenic infection of the parotid gland may occur as a postoperative complication in infected operative cases about the pharynx and mouth, or they may in themselves be a primary condition. The infection may be hematogenous or ascending. In a series of thirty-nine cases (Blair and Padgett), thirty-four occurred in the winter, and with pneumonia present in approximately one-third of the cases. Most cases are unilateral, but the condition may be bilateral. Although the symptoms may in the beginning be mild, with little fever, slight pain and discomfort and moderate swelling, as a rule, the onset is sudden, with a rapid course of pain, marked swelling and general constitutional symptoms indicative of a severe infection. Intra-oral examination will disclose redness of the duct, with a drop of cloudy or purulent saliva. If the infection is not controlled, it may extend toward the eye and down the neck. If the constitutional symptoms are severe, the prognosis is grave. Deaths have been reported as occurring during the period of acute swelling, which may be indicative of edema of the glottis.

Treatment.—The treatment will vary according to the severity of the case. In mild cases, meatotomy of the duct and drainage may suffice, with moist applications extra-orally. In the presence of suppurative processes, drainage must be promptly and energetically carried out. If drainage through the duct is not effective, the extra-oral approach should not be delayed. The gland should be exposed by making a right-angle incision

with the vertical incision immediately in front of the ear, and the horizontal along the zygomatic arch, avoiding the facial nerve. The incision should extend merely through the skin and superficial fascia. The flap is reflected forward and the capsule of the gland exposed and punctured in many places with blunt-pointed scissors, the operator punching with the scissors and tearing by opening the blades. These multiple punctures should be scattered throughout all parts of the gland. The skin should not be sutured, the wound being packed lightly with gauze and bandaged or having wet dressings applied. Any salivary fistulae that develop after complete healing can be treated as described later. Sulfanilamide should be administered.

I have never observed a case of acute suppurative infection of the submaxillary gland. Most of the cases have not been of the real suppurative type, but have always been secondary to obstruction. Repeated obstructive attacks in the submaxillary gland seem to result in greater fibrotic changes than those occurring in the parotid gland. Such a submaxillary gland becomes rather hard, and somewhat tender on deglutition.

SALIVARY FISTULAE

Salivary fistulae usually occur in the parotid gland. They may be divided into two groups: the first, fistulae of the glandular portion; the second, fistulae of the duct. It is important to diagnose the type of fistula, since the method of treatment varies. The exact site of the discharging opening should be noted, and this will usually aid in determining whether the glandular, that is the secreting portion of the gland, or the duct system is affected. Fistulae of the duct are usually the result of trauma, surgical or accidental, while gland fistulae result from abscess formation, or are possibly of operative origin. The diagnosis is usually simple, although in doubtful cases injection of lipiodol and roentgen visualization will be very useful. (Fig. 20.) The glandular type of fistula is usually responsive to simple treatment: The fistulous opening may be cauterized or excised, although the latter is preferable, and the freshened wound edges sutured. Intermaxillary wiring should be applied and maintained for about two weeks and, at the same time, a pressure bandage should be applied. The diet should be bland, with small doses of atropin to keep the salivary gland at rest. In persistent cases not cleared up by surgical procedure, section of the auriculotemporal nerve has been suggested.

Fig. 20.—Injection of parotid fistula. The needle has been inserted in the fistulous opening. The opaque rectangle is an adhesive strip holding the needle in situ.

Irradiation by x-ray or radium will

destroy the secreting function of the gland.

Fistulae of Stensen's duct may for operative purposes be divided into "anterior" and "posterior" fistulae; that is, those anterior to the masseter muscle and those in the masseteric portion of the duct. In the anterior fistulae, the simplest method of treatment is to make an elliptical-shaped incision about the fistula on the cheek and carefully dissect the duct backward for a short distance. An opening should then be made into the mouth through the cheek and the end of the fistula should be brought through and sutured to the oral mucosa. The cheek opening can then be closed. This method is useful only when the remaining portion of Stensen's duct is long enough to be brought through the substance of the cheek into the mouth. Some external fistulae can be converted into

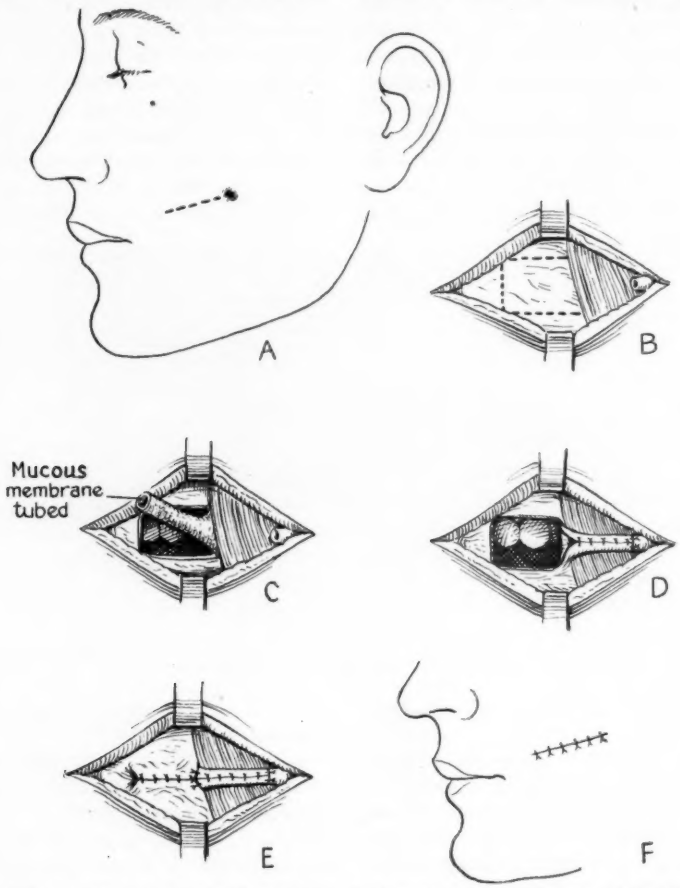

Fig. 21.—Restoration of parotid duct by means of mucous membrane tube. The broken line (A) indicates the incision from the fistula forward, extending to, but not through, the mucous membrane. B, outline of flap to be tubed. The remnant of the duct is seen on the right. C, flap tubed with mucous membrane as lining. D, tube hinged over and sutured to freshened stump of duct. E, closure of oral mucous membrane. The sutures should be tied inside the mouth. F, skin closure. (Barsky: Plastic Surgery.)

internal fistulae by making an opening from the mouth through the cheek to the fistulous opening on the cheek. The opening on the cheek should have the edges freshened and sutured. Then a small rubber tube is inserted through the tract dissected from the mouth. As this tract epithelizes, the tube can be gradually shortened or be removed.

In posterior fistulae, if the duct is too short to be brought through the cheek, a new duct can be created out of the oral mucosa. (Fig. 21.)

TUMORS

The subject of tumors of the salivary glands is a very important one. For dental surgeons, who every day make many oral examinations, the important part of the subject is not the treatment of the tumors, but the diagnosis.

Tumors of the salivary gland vary from benign adenoma to malignant adenocarcinoma and carcinoma and mixed tumors. Although growths occur in the submaxillary gland, the parotid is the one most frequently affected, and the sublingual least often. Adenoma is rare, carcinoma less rare. Most of the tumors appear to be of mixed type. Benign adenoma may undergo transition into malignant adenocarcinoma.

Carcinomas usually develop rapidly, and although they may at first be encapsulated, the entire gland, its capsule and the region around the lymph nodes may soon be invaded. The growths are solid and firm, and in many cases lobulated. Sometimes continuous salivation has been noted. Adenocarcinoma and carcinoma of the salivary glands are often fatal and metastasize early.

Mixed tumors may occur at any age, having been described in an infant of 7 months and a person of 72 years. However, most of the cases occur in patients between 20 and 40 years. Some very slow-growing tumors have been present from birth. In many cases, the growth of nodules has been observed over a period of from eight to ten years, and in one instance, over a period of fifty-three years. There is a wide variation in the clinical course and behavior of these tumors. After surgical removal, an encapsulated tumor usually does not recur, On the other hand, non-capsulated tumors removed surgically have recurred as late as nine years after operation. The lymph nodes are not usually invaded by this type of tumor unless operated upon. The tumor usually begins as a small nodule in or about the region of the gland, growing slowly within its capsule until it reaches a large size. Fusion with the glandular septa may take place, thus making it necessary to remove portions of the gland in extirpating the tumor. The tumor may begin in almost any part of the gland, some even developing along Stensen's duct, others below or behind the ear. For this reason, I believe the term "mixed tumors of the parotid region" should be applied here, rather than "mixed tumors of the parotid gland." The growths are usually firm and hard.

The treatment is surgical operation or irradiation.

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PRESIDENT'S ANNUAL REPORT

By OREN A. OLIVER, D.D.S., Nashville, Tenn.

AT THE meeting in Houston last year a recommendation was adopted that the annual report of the President be read to the House of Delegates. In complying with this rule, I have taken the liberty of condensing my printed report to some degree, without, I hope, impairing its value.

In presenting this report, I assure you that I have a deep appreciation of the problems which our country now faces and of the grave responsibilities which have come to the organized dental profession as represented by this Association. It is the acceptance of one phase of responsibility which has caused postponement of our Boston meeting and has limited this session to attendance by Delegates and members of standing committees. This is the first time that any annual meeting of the Association has been postponed. However, the cause is great, and while postponement has caused inconvenience to many persons, the present emergency demands sacrifices at many points and full cooperation with the Government in the interest of victory and the welfare of those in the armed forces.

When the last Annual Meeting was held, in Houston in October, we were in a period of national defense. After December 7, the period of watchful waiting ended, and armed conflict became for us the order of the day. We are now in the war, and as President Roosevelt has said, "We are in it all the way." Furthermore, we are involved not in a simple war, but in a total war that touches every man, woman and child in America and calls for a solid and effective home front. Organized dentistry is a part of that front. Whatever the specific problems of dentistry may be, our compelling and immediate task is that of contributing as individuals, and as an association, to the total overthrow of Hitler, of Mussolini and of militaristic Japan.

It is fortunate that during the period of national defense, and in fact from the very beginning of that period, the American Dental Association had the machinery for active cooperation with the Government already fully established. The sudden transition from peace to war found the Association wholly ready to aid the Army, the Navy and other branches of the Government in the war effort. Preparedness in this case was far-sighted and profitable. Because of it, the Association has been able to act so quickly and to cooperate so fully, as the emergency became more intense, that, I am sure, we have everywhere won increased respect and regard for dentistry and for the Association.

Because of the emergency, it was deemed wise to visit as many state and component societies as possible. Twenty-two state society meetings were attended,

Presented at the annual meeting of the House of Delegates of the American Dental Association, St. Louis, Mo., August 26-28, 1942.

also the Five State Post Graduate Clinic, the Thomas P. Hinman Mid-Winter Clinic, the Chicago Midwinter Clinic and a number of district societies. These visits, in addition to attendance at many conferences in Washington, required more than 67,000 miles of air travel. I mention these miles of travel only because I want to assure you that it offered excellent opportunities to secure an overall picture of dentistry in the present emergency. Here, I should be neglecting my duty if I did not tell you of the alertness, the desire to cooperate and the generally fine attitude of the profession in the United States. Since the beginning of the emergency, dentists have been ready and willing to go to the limit in cooperating with the Government and with the Association. One can only be more proud of his profession and have greater assurance that the future is secure when observing such a widespread spirit of cooperation.

Today, we find the American Dental Association operating at full capacity in the war effort. We also find the Association with a larger membership than at any other time in its history. The Association has its war program; and it is of course difficult now to consider at length anything other than making that program a success. Postwar planning, however, is now going on in all of the United States of America. In other words, it seems that while winning the war, we must prepare for peace. In fact, it is imperative that we do so; for the orderly transition from war to peace means control of the forces evolving out of demobilization of the Army and Navy and the major and minor war industries. It means that the country will be faced with a problem of social and economic adjustment terrific in its import to every man, woman, and child.

War, it is well to keep in mind, is the most potent revolutionary force known to man. This is especially true of total war. War is a revolutionary force, not only in the political sense, but in many other ways—social, economic, scientific and professional. It will touch every phase of American life and will leave its mark for many years to come. Realization of the revolutionary forces that dentists face as an organized profession should arouse us to a serious contemplation of the future and of the part that we may play in the promotion of health and of the democratic way of life.

One of the most active and effective committees of the Association during this administration has been the Committee on Dental Preparedness. This committee has been confronted with many perplexing problems throughout the year and the results indicate that the interests of the profession have been zealously guarded.

Some of the activities that have occupied the attention of this group are briefly enumerated, with the view of acquainting the members of the House of Delegates with the results that have been obtained.

1. Inducted Dentists. In the early part of the preparedness program, and later in the war effort, much difficulty was experienced because of the induction of dentists into the Army as private soldiers. Although the number inducted caused great alarm, one has but to compare the figures of the present war with those of the war of a quarter of a century ago to see that conditions in this respect are much better.

In the experience that we have just had, approximately 250 dentists were inducted as privates. At the present time, nearly all of these men have been commissioned, but in World War I, at the time the war closed, there were in one camp more than 1,000 dentists who were serving as privates. Surely this record speaks for itself.

2. Medical Administrative Corps. To continue the supply of dentists to meet accumulated needs, it is necessary that dental students be permitted to finish their education. Unfortunately, the Selective Service Boards were not familiar with the impending national over-all

shortage of dentists, and, as a result, some difficulty was experienced through the drafting of students.

The Navy offered some assistance by making available the Ensign (H-V[P]) Commission, but all students could not be accommodated in this service; hence, it was important that some similar provision be made by the Army.

Several requests were made for the inclusion of dental students in the Medical Administration Corps, but each request was denied. Finally, after continued effort, the regulations were changed to include dental students. This now makes commissions available in either the Army or the Navy, and thus the student body is protected.

3. Gasoline Rationing. This problem was another difficult one confronting the committee. In the beginning, dentistry was unfortunately overlooked in the rationing provisions. Just as the regulations were about to be revised, the position of dentistry was clarified. As a result, the present regulations provide for "preferred mileage" rations for those dentists who can demonstrate their right to be so classified. The most recent reports indicate that, by and large, the dental profession is receiving its rights.

4. Civilian Defense. Again, in this important matter, dentistry was excluded in the original organization. This matter was brought to the attention of the heads of this agency, and dentistry was assured that arrangements would be made to include it in the final program.

This committee became active and, as a result of this activity, dentistry has been inserted in the primary organization chart, and from that point on to the local level, dentistry now is taking its proper place.

Bulletin 1 has already been published by the committee, and plans are now under way for the publication of a second bulletin, which will deal with the treatment of wounds.

5. Quota and Age Survey. Another important activity has been the preliminary work on a study of dental quotas for the armed forces. An age analysis of the dentists of the United States has also been partially completed, and when this is finished, it will be an important document. This is one of the parts of a far-seeing program on which the committee has been working.

6. Procurement and Assignment Service. Again, this committee was responsible for beginning an important action in behalf of dentistry. December 18, 1941, two weeks after Jap Sunday, the Committee on Dental Preparedness recommended the present dental organization of Procurement and Assignment. Results speak for themselves, and the present pattern that is outlined indicates a successful solution of the problem.

In presenting this report, I wish to express my sincere appreciation to the committee as a whole, and to Dr. Camalier and Dr. Timmons in particular for their efforts.

Today finds the American Dental Association at the most crucial point in its history, operating at full capacity in its attempt to meet the needs of the armed services and the civilian population. Here, I should like to point out specifically the accomplishments of the American Dental Association during the past year.

1. We now have the largest membership in the history of the Association, a membership which numbers 54,269. The Junior Membership is double that of the previous year.

2. There has been appointed a subcommittee on dentistry of the Health and Medical Committee, which is the policy-making agency of the Office of Emergency Management in health matters. I am glad to say that a dentist has been appointed as a member of the main committee, the Health and Medical Committee.

3. A dentist has been appointed to the Procurement and Assignment Board, and there is also a committee on dentistry of the Procurement and Assignment Service.

4. A dental representative has been appointed to the Medical Advisory Board of the Office of Civilian Defense, and the position of the dentist in civilian defense has now been clearly defined.

5. The Medical Administrative Corps of the United States Army and the Naval H-V (P) Reserve have been opened to dental and predental students. Students enlisting in these reserves may receive commissions as second lieutenants or ensigns.

6. Priorities have been secured so that it is now possible to proceed with alteration of the new Association building, final purchase of which was made during the year.

7. A dentist is now an officer on all Army medical recruiting boards.

8. The Executive Secretary of the American Dental Association has been appointed consultant to the Office of the Procurement and Assignment Service.

9. A bill has been introduced in Congress looking to the appointment of a rear admiral in the Office of the Surgeon General of the Navy who would supervise dental affairs.

10. Publication of a midmonthly supplement to the JOURNAL OF THE AMERICAN DENTAL ASSOCIATION was begun during the year, and it is hoped that this will meet a long-felt need in the Association.

11. Maj. Kenneth R. Cofield has been assigned by the Army to the offices of the American Dental Association.

12. The Council on Dental Education has reached a point in its work where it is to begin the inspection of dental schools in September.

13. A national program for the control of dental caries has been adopted by the National Health Program Committee and the Board of Trustees. This program is one of the outstanding movements within the Association, and you can expect to hear more about it later.

14. Letters have been sent to all members of the American Dental Association regarding the purchase of defense stamps and bonds, and we have expressed our willingness as an Association to cooperate with the Government in this worthwhile movement.

15. The Trainor Bill for the control of laboratory technicians has been introduced in Congress.

16. A dentist was appointed on all local examining boards and on all medical advisory boards.

17. In the set-up of Procurement and Assignment Service, a chairman for dentists was appointed in each state and a dental consultant and a dental member for dental education were appointed in each Corps Area.

18. The first Inter-American Orthodontic Congress was held in New Orleans in March. Twenty Latin American countries and Canada were represented. At the close of the Congress, these representatives proceeded to Washington, where they were given a course in dentistry by the United States Army Dental Corps at Walter Reed Hospital. Thereafter a number of these men went to the University of Michigan for a course of study under the auspices of the W. K. Kellogg Foundation. The congress was an accomplishment as a good will conference between the United States and the Latin American countries.

19. In regard to the tire rationing situation, a brief has been presented to the Tire Rationing Board setting forth the reasons that the dental profession, the second largest health organization, should have the same recognition as the medical profession. It is our belief that we will receive this recognition in a short time.

20. The History Committee is now accumulating all possible data and information pertaining to the history of dentistry. Any one having any information of interest, particularly with reference to the war, is asked to send it to this committee. We believe that it is much better for activities of importance to be recorded at the time, to avoid any controversies that may arise.

RECOMMENDATIONS

1. Pan-American Membership.—I wish to recommend that dentists who practice in the countries of the Americas, exclusive of the United States and its territorial and insular possessions, shall be eligible for Pan-American membership in the American Dental Association, provided they are members in good standing of their own national societies, application for such membership to be accompanied by certification from the secretary of the national dental organization in which the applicant holds membership. The fee for Pan-American membership should, I think, be $5, and the member should receive a Pan-American membership card and also receive the JOURNAL OF THE AMERICAN DENTAL ASSOCIATION and a copy of the Annual Events Program and be privileged to attend the meetings of the American Dental Association.

2. I wish to recommend that in Chapter I, Section XI, of the Administrative By-Laws, the words "life member" be substituted for the words "affiliate member" wherever the latter words occur. The inference in the term "life member," as it is ordinarily considered, is, I think, that these members are entitled to all of the rights of regular membership without the payment of dues. This would not be implied in the use of the term "affiliate member," which would, strictly speaking, mean one who is often called an "associate member."

3. In view of the activities of the National Health Program Committee for the establishment of a caries control program on a national basis, and also in view of the many responsibilities in the field of public dental health facing the dental profession in the postwar period, it is important that the health activities of the American Dental Association be given the most serious consideration.

At the present time, we have two committees in the field of dental health. In the interest of economy and efficiency, I recommend that suitable changes be made in the By-Laws to provide for a council on dental health to take the place of these two committees, the National Health Program Committee and the Committee on Public Health and Education; that these committees be dissolved and the duties and functions of these two committees be taken over by the proposed Council on Dental Health, and that this proposed council also be given the responsibility and obligation of developing the dental caries control program as recommended by the National Health Program Committee and the carrying out of such other functions as may naturally fall in the field of dental health.

4. I wish to recommend that the first sentence of item B, Section 7, Chapter II, of the Administrative By-Laws be amended to read as follows: "Each state dental association shall select one representative from its membership to cooperate with the Dental Relief Fund Committee in the collection of relief funds within each state association."

5. At the last meeting of the House of Delegates, in Houston, the dues of the local and state associations were suspended for the men in service, and one-half of the national dues were returned to the state and local societies. Since that time, a large number of our members have gone into foreign service, or have gone on duty outside the United States, and are making great sacrifices. I, therefore, recommend that the dues of the local and state organizations and of the American Dental Association of all dentists on foreign duty be suspended for the duration of the war.

6. Since the two paragraphs under Patents, Section 12, of the Code of Ethics, are not clear and could be interpreted in many ways, I recommend that they be changed to read as follows:

a. Patents and Perquisites—It is unethical to receive remuneration from patents for dental instruments or medicines;

or to accept rebates on prescriptions or dental appliances, or perquisites from attendants who aid in the care of patients.

b. Dental Laws—Secret Remedies—It is unethical for a dentist to assist unqualified persons to evade legal restrictions governing the practice of dentistry. It is equally unethical to prescribe or dispense secret medicines or other secret remedial agents, or to manufacture or promote their use in any way.

7. One of the objects of the Dental Preparedness Questionnaire was the publication of a complete dental directory. The publication of this directory has been authorized by the House of Delegates and, at the Annual Meeting in Houston, money was appropriated to begin the publication of the volume.

Although the returns from the questionnaire have been sufficient to warrant the continuation of this project, a serious obstacle has arisen because of the war. From all indications, at least 20 per cent of the entire profession will be dislocated before the termination of the conflict. This figure may reach a higher total, but, for the present, it appears that 20 per cent is a conservative estimate. On this basis, it appears that it would be an error to publish a directory 20 per cent of which would be wrong before it was published. I therefore wish to make the following recommendation:

That the publication of the directory be postponed until such time as a more settled condition prevails. This, however, is not to be construed as a recommendation that work on the maintenance of suitable lists be discontinued. The groundwork which has been laid by the distribution of the questionnaire should be continued, and thus we can be prepared for the publication of the directory when the proper time comes.

Too much credit cannot be given to the persons who participated in this effort. It was a difficult task and presented many problems. The persons in the Central Office, together with the state officers and committeemen, have rendered a valuable service because we now have in the Central Office more information concerning dentists of the nation than we have ever had.

8. History in the past has been written from letters, largely personal, from a little recorded material and from memory, with no great amount of material gathered from factual matter that is without controversy. We must use this material, nevertheless, in the form in which we find it. However, we must admit that activities and works of importance should be recorded, authenticated and dated when done, with credit to those to whom credit is due. Had this policy been followed in the past, there would have been no controversy about who was the discoverer of either nitrous oxide or ether anesthesia. Therefore, I recommend that the House of Delegates instruct the History Committee to give consideration to the selection and employment of a person capable of compiling dental history as it is being made today and coordinating this with the history of the past. I would suggest the following qualifications for the person to be chosen:

1. A young man, preferably a dentist.
2. One educated in history, including dental history.
3. One with an international concept of the work entailed.
4. One capable of writing and of proven ability.
5. One acquainted with the dentists of the world.
6. One who knows where material can be found, in contrast to one who must seek such literature, as well as develop a familiarity with the facts.

May I say a word regarding the cooperation which the Association and its President received from Brigadier General Leigh C. Fairbank, now retired. General Fairbank went to the limit in cooperation, and was of great assistance at many points. The present brigadier

general in the Dental Corps, Robert H. Mills, who began his duties at the Surgeon General's Office in March, is cooperating in every way, and, at the same time, the Association, through its offices, is attempting to give General Mills all possible assistance in order that dentistry may meet its responsibilities in this emergency.

What I have said regarding General Fairbank and General Mills applies to Captain Albert Knox of the Navy. From the beginning, Captain Knox has worked with the President of the Association and with the officers and committees, giving his time wholeheartedly toward the solution of problems that have been presented to him. In fact, all the agencies of the Government and their offices have been courteous and cooperative throughout the year, and, as time has passed, we have been more and more encouraged to do our utmost in the way of assisting these Government agencies.

All of the committees of the Association have worked hard during the year and, while some committees have carried greater burdens than others, the voluntary contributions by committee members in the interest of the war effort, and in the advancement of their profession, have been outstanding. Not all of the members of this Association realize just how much time and effort many of these committee members contribute. However, it is men like these who have advanced dentistry to its present high position, and who will advance the frontiers in the future. Their work should receive the commendation of every member of the Association.

Aside from the accomplishments of the past year, I should like to point out that there is a growing awareness of the significance of organized dentistry in terms of public health and in the advancement of dental practice. Not only is there a greater appreciation at these two points, but there also appears to be a broader vision.

Finally, I should like to take this opportunity to express my deepest appreciation for the cooperation that I have received from the officers of the state associations, the Officers and committees of the American Dental Association, the Board of Trustees, the members of the staff at the Central Office and especially the members of the Local Arrangements Committee and various chairmen in Boston who had worked so diligently to make the meeting in Boston a success.

I should like to point out that organized dentistry was born in a democracy as was dental education. Both have gone farther in this democracy than in any other country in the world. Since 1839-1840, when organized dentistry was begun in this country, and back to 1776, we have been blessed with freedom of speech, freedom of thought, the right to assemble and the right as free men to cast our ballot or to raise our voice in the interest of our country's welfare and for the advancement of our profession. These are the things that we are now fighting for, and they are what we must preserve at all costs. They are for free men, and, with them, we can go on pushing forward the frontiers of dentistry as a public service. Without them, dentistry will be nothing and our professional boundaries will recede. Knowing what we want, I am certain that, in the end, we will get it. But we must now give rather than take, and as citizens, and as professional men, present a dynamic front against which the enemies of free men cannot stand.

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THE DENTIST IN THE ARMY

MUCH concern has been expressed in administrative and Army circles regarding the shortage of manpower in the effort to supply adequate health service to the civilian, industrial and military populations of the country, and it is becoming more and more apparent that every possible resource will have to be called upon to meet the need of an army of such proportions as are almost inconceivable as measured in terms of the past. And it now appears likely that the health service of the Army, particularly in combat, may be effectively augmented through an enlargement of the scope of the combat service of the Dental Corps.

In the shortage apparent from the most recent appraisal of the medical health service manpower, and the seeming tardiness of the medical profession to volunteer its services in sufficient amount, Mr. McNutt's ultimatum to the medical profession to the effect that if the necessary manpower were not readily available through volunteer sources, other sources would be sought, assumes a significance that may well be seriously considered by the dental profession.

While the demands from the armed forces upon the dental profession have not yet become alarming, it is quite possible that the scope of

service of the Dental Corps may be enlarged in an effort to meet the inordinate military medical need.

'Tis indeed an ill wind that blows no good, and in such an eventuality as is above visioned, an opportunity will be afforded and an obligation accordingly imposed on the dental profession to demonstrate once more its usefulness and helpfulness as a health service of more than specialty proportions.

In the First World War, an exceptional opportunity was afforded the dental profession to prove its value as an auxiliary to the medical corps, and the Dental Corps acquitted itself in a magnificent manner and to the glory of dentistry; so much so, that many have thought that the Dental Corps was deserving of sufficient recognition to be given equal status with the Medical Corps rather than being subordinate thereto.

The opportunity for again convincingly demonstrating our value, such as may be afforded by the present war emergency, makes it urgently desirable and even necessary for the profession to be prepared to embrace the opportunity and to accept the corresponding obligation.

The function and duties of the Dental Corps in the draft and induction phases of the war effort is purely dental; in preparing the draftee for service, and, in the training and field activities of the new recruits, the duty of the dental corps is to maintain the oral apparatus of the new recruits in healthful and efficient working condition. In combat service, however, little of what we know as operative dentistry is practiced. The dental officer then becomes an auxiliary to the medical corps and is more than ever a part of the Medical Corps, subject to the call and direction of the medical head of the unit or division.

In this new status, as it were, he is subject to emergency service of the same character as that of his medical brother, and is responsible for any medical duty assigned to him, these duties extending to the point of definitive treatment outside of the dental field. Definitive treatment, which in this instance would mean treatment directed toward alleviation of diseases and injuries other than those of the mouth and jaws is given mostly behind the lines in the field and base hospitals. Emergency limb amputations would be classed as definitive treatment and therefore would not ordinarily come within the dentist's function. It is readily conceivable, however, and it has actually occurred, that a dental officer has become, in an emergency, head of the medical unit and has been called upon to perform serious operations far outside the limited dental field.

Already in the present conflict, there have been numerous instances

in which the oral surgeon has received distinguished honor for services outside the strictly dental field. The dentist is capable, by virtue of his highly developed mechanical skill and his knowledge of anatomy, of performing surgical operations in other parts of the body.

In other words, in combat service, the dental officer is seldom called upon to do operative dental work. He becomes an auxiliary officer of the medical corps under orders from his superior medical officer, and his duties are limited only by his capabilities.

The character of warfare in the present conflict, although somewhat different as to firearms and diversification from that of the First World War, produces a large percentage of injuries of the jaws and wounds about the face, for the treatment and care of which the dental surgeon and the maxillofacial surgeon are well qualified.

As an example of the facility of the oral surgeon in handling injuries of the face and mouth, Georges Villain, head of the Dental Corps of French Army in the First World War, did yeoman service in returning these injured to combat service. At a time when the manpower of the French Army was threatened with serious depletion, the dental profession, under the direction of Dr. Villain, restored to combat service more than 200,000 men through restorations of the face and rehabilitation of the dental apparatus. Such restorative dental work makes the Dental Corps indispensable to the Army in the rehabilitation and return of the injured to line service. Incidentally, the dentist, in caring for mouth and face wounds in combat service, is qualified to treat these injuries in such a manner as to more readily facilitate restoration after the wounds have healed.

It then seems reasonable to assume that the character and number of wounds of the face and jaws in the present conflict may afford the dental surgeon an opportunity to enhance his value materially in war service. The dental profession is already alert to the possibilities in this direction, as witness the proposed course in military surgery to be given in Chicago, the latter part of October, by the Chicago Dental Society. This society is to be highly commended for its efforts to better equip the dentist for anticipated health service needs in the present war emergency.

If dentistry realizes its opportunity and the members accept the obligation seriously, we shall be able to demonstrate effectively the possibilities of dentistry in the prevention and relief of human suffering. It then will inevitably follow that dentistry will achieve recognition from the government and the public otherwise unattainable.

BIBLIOGRAPHICAL

Synopsis of Pathology

By W. A. D. Anderson, M.A., M.D., Assistant Professor of Pathology, St. Louis University School of Medicine. Pathologist, St. Mary's Group of Hospitals. 661 pages. 294 text illustrations and 17 color plates. Cloth. Price $6. St. Louis: C. V. Mosby Company, 1942.

This volume is designed to fill the gap which exists between the very elementary manuals of pathology, and the many excellent larger textbooks. Rather than be exhaustive, the author has chosen to present pathology in a compact, condensed form. As a result, this book is a good summary of general pathology. Oral pathology is almost entirely ignored.

Many valuable tables, charts and outlines are included and the illustrations are unusually good. Excellent references to current literature are given in each chapter.

Because of its brevity, this book cannot be recommended as a textbook or reference book in general pathology. However, it should prove helpful to students studying general pathology and to practitioners who must maintain familiarity with the general subject of pathology.

A Textbook for Dental Assistants

By Irwin Robert Levy, D.D.S., formerly Director, American Training Institute; Chief of Dental Clinic, Big Sisters Organization; Assistant Dentist, Mt. Sinai Hospital; New York City. 239 pages. 217 engravings. Cloth. Price $3.50. Philadelphia: Lea & Febiger, 1942.

The dentist can save considerable time and bother by presenting the inexperienced dental assistant with a copy of this neat little "Textbook for Dental Assistants." The management of each dental office should vary with the personnel, and the dentist will wish to train his assistant to cooperate with him. Nevertheless, many technical details can be learned from this text, to the advantage of both dentist and assistant.

The author has not attempted to teach dentistry in this book. He includes only dental information that will be helpful in forming a background for the dental assistant. A limited amount of technical information is presented in an interesting and terse manner. More than 200 carefully chosen illustrations make the text easily understood.

The many duties of the dental assistant are considered in separate chapters as follows: chairside assisting, dental office management, dental anatomy, sterilization, dental radiology, oral surgery, periodontia, oral hygiene, pedodontia and orthodontia, models in casts and gold inlays. The chapter on dental radiology is especially well illustrated.

A glossary of about 1,500 commonly used dental terms conclude the book. This glossary should prove helpful to the dental assistant, although the definitions are almost too brief, and one wonders why such words as "water," "swallow," "soft," "hard" and "rot" are included.

Careful reading of this book by the inexperienced assistant should prove valuable for its discussions of many of her duties.

Books Received

Accepted Dental Remedies

Containing a list of official drugs selected to promote a rational dental materia medica and descriptions of acceptable nonofficial articles. Eighth Edition. Council on Dental Therapeutics, American Dental Association, 212 East Superior St., Chicago, Ill. Price $1.

Orientation in American Dentistry

Its History and Social-Professional Background—A Text-Workbook for Dental Students and Professional Health Workers. By Alfred J. Asgis, M.A., Ph.D., D.D.S., Assistant Professor of Oral Surgery and Lecturer on Orientation, New York University College of Dentistry; Author of "Public Health Dentistry and Health Security," "Outline of Dental Socio-economics," "Functional Dental Education," "Professional Dentistry in American Society," Etc., Etc. Second Revised Edition. Cloth bound. Student edition, 176 pages, $3.50; Limited edition, 260 pages, $4.50. New York: Clinical Press, 1123 Broadway. 1942.

ASSOCIATION ACTIVITIES

Contents

PRESIDENT'S MESSAGE

The Washington Office 2058

WAR SERVICE COMMITTEE

Complete Survey of Dental Laboratory Technicians 2060

BUREAU OF PUBLIC RELATIONS

Educational Material for the Children:

Tommy's First Visit to the Dentist 2061
First Grade Dental Health Leaflets 2061
Second Grade Educational Leaflets 2061
Third Grade Educational Leaflets 2062
Happy Days with Jack and Joan 2062

COUNCIL ON DENTAL THERAPEUTICS

Is Fluorine a Therapeutic Agent for Dental Caries?
Harold C. Hodge, Ph.D. 2063

Accepted Dental Remedies 2068

COUNCIL ON DENTAL HEALTH

Report of Organization Meeting 2069
High School Victory Corps 2073

COMMITTEE ON LEGISLATION

Recent Amendments to the Soldiers' and Sailors' Civil Relief Act 2074

COMMITTEE ON ECONOMICS

A Study of the Rising Costs of Conducting a Dental Practice
R. M. Walls, D.D.S., and M. L. Dollar 2077

AMERICAN DENTAL ASSOCIATION MEMBERSHIP PAGE 2093

RELIEF FUND COMMISSION AND DENTAL RELIEF FUND COMMITTEE

Report of Secretary 2094

President's Message

THE WASHINGTON OFFICE

BECAUSE of situations affecting dentistry which are constantly arising among government agencies and departments of the military, it has become increasingly apparent that the A. D. A. should expand its facilities in Washington to meet changing conditions that are of vital importance to the profession. As a consequence, the Board of Trustees recommended, and the House of Delegates approved, a plan for establishing a temporary office in Washington with a part time director in charge. In pursuance of this authorization, an office has been established at 1726 Eye Street, N.W., Washington, D. C. It is adequately equipped and is supplied with clerical assistants essential to the care of the pressing governmental and military problems with which it must deal. In order to provide this activity with experienced and capable leadership, it was decided to appoint as director the chairman of the War Service Committee, C. Willard Camalier.

Dr. Camalier brings to this work a long experience in A. D. A. activities, including the Presidency of the A. D. A., the chairmanship of the Committee on Dental Preparedness since its creation, membership on Procurement and Assignment Service, advisor to Selective Service, with many other important duties that acquaint him thoroughly with the federal and the military situations. He will be assisted in his duty by the members of the War Service Committee: Gerald D. Timmons, George M. Anderson, Holly C. Jarvis, Henry O. Lineberger, P. C. Lowry, Oren A. Oliver and B. K. Westfall.

Among the problems now requiring the attention of the director are: tire and gasoline rationing (now satisfactorily adjusted); dental care in defense areas where dental personnel shortages exist; the fixing of dental quotas for the various states to meet procurement objectives; Selective Service disposition of dentists; a national salvage program; conservation of dental equipment, instruments and supplies; dentistry's participation in Civilian Defense; survey of dental laboratory personnel, and many other questions that require immediate and decisive action.

In addition to the functions of the War Service Committee, certain activities of the Committee on Legislation, under the direction of its chairman, Sterling V. Mead, are administered from this A. D. A. office. There are a number of bills affecting the dental profession now before the Congress for action. Among them are H.R. 6730, introduced by Congressman Traynor, Delaware (S. 2371, Senator Tunnell, Delaware), "A bill to protect the public health by the prevention of certain practices leading to dental disorders; and to prevent the circumvention of certain states or territorial laws regulating the practice of dentistry"; H. R. 7243, introduced by Congressman Vinson, Georgia (S. 2769, Senator Walsh, Massachusetts), "To authorize the rank of rear admiral in the Dental Corps of the United States Navy"; H. R. 7616, introduced by Congressman Bulwinkle, North Carolina, "For the organization and functions of the Public Health Service"; S. 2842, by Senator Taft of Ohio, "To provide for the more effective utilization of the nation's manpower resources and for other purposes." All of these legislative matters are of great concern to dentistry and are receiving the earnest and immediate attention of the Committee on Legislation.

The office of the American Dental Association in Washington is an essential temporary arrangement designed to meet an emergency. It is located at the center of initial activity of the government and the armed forces and is manned by capable committeemen earnestly concerned with meeting all situations promptly, and with directing all movements involving dentistry into the proper channels. The office is visited almost daily by the President and the President Elect of the American Dental Association, who are cooperating to the fullest in the effort of the national organization to meet effectively war problems and war situations which are so vital to the present and are sure to affect profoundly both the current usefulness and the future character of dentistry.

WAR SERVICE COMMITTEE

COMPLETE SURVEY OF DENTAL LABORATORY TECHNICIANS TO BE UNDERTAKEN BY COMMITTEE

A LIMITED survey of dental laboratory personnel, disclosing an imminent shortage in trained workers, has prompted the War Service Committee to undertake a complete study of dental laboratory technicians in America. This announcement was made by C. Willard Camalier, chairman of the committee, who stated that the survey "will provide information that will enable authorities to supply the maximum amount of high quality dental laboratory services to the armed forces and to the dental profession that is serving the public."

The limited survey was made early last summer by the Research Organization of the Certified Akers Laboratories Group and the Dental Laboratory Institute of America. Its purpose was to study the impact on dental laboratory personnel of voluntary enlistments, inductions through Selective Service and the attraction of other war industries. Questionnaires were mailed to 386 laboratories, with 259 returns.

This number of laboratories employed 3,050 technicians, of whom only 266 were not subject to military service because of age. The laboratories also reported that 655 technicians had already entered the armed services, with 288 of that number taking up work in the Dental Corps. An average increase of 15 per cent in volume of business was also reported.

From other figures compiled by the Dental Laboratory Institute of America, it was shown that there are 3,421 dental laboratories in the United States employing 12,320 dental technicians. The ratio of dentists to laboratories was established as twenty-two dentists to one laboratory; the ratio of dentists to technicians, as seven dentists to one technician.

The increasing volume of business from civilian dentists, the flow of dental technicians into the armed services and the additional calls for technician personnel that an increasing army necessitates all contribute to the shortage of trained dental technicians. In an effort to relieve this shortage, the national Selective Service System addressed a memorandum to all local boards on July 15, 1942, asking that technicians be deferred as essential to the war effort. Definitions for the terms "senior dental technician" and "junior dental technician" have also been established in order to aid in the conservation of skilled technicians.

The survey stated that "since the dental laboratory industry is an essential adjunct service to the dental profession, a survey of the industry's manpower should be made, and sound steps taken to conserve and utilize the skill and experience of these craftsmen for the duties they are best able to perform."

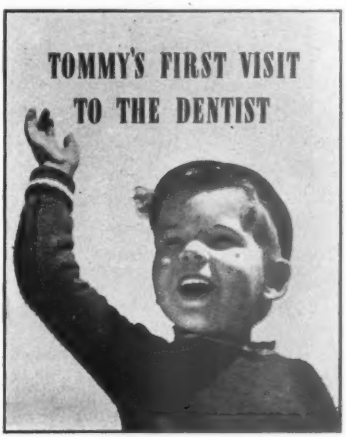
A more comprehensive study is now being made of this problem at the expense of the American Dental Association. Constituent and component societies should cooperate in the survey if requested to do so.

BUREAU OF PUBLIC RELATIONS

EDUCATIONAL MATERIAL FOR THE CHILDREN

SCHOOL days are here again, bringing with them an expanded and accentuated program of health education. Every dental society in America, indeed every member of the American Dental Association, can patriotically participate in this program.

Reports from Selective Service indicating that dental disease was the most prevalent of all disqualifying defects among selectees have awakened the American public to the importance of preventive dentistry. Educators, public



health nurses and others interested in the health and welfare of American youth need authentic dental health educational material. The five pieces listed in this article have been prepared by the Bureau of Public Relations for use in elementary schools. Your society can perform no finer public relations work during the coming year than to make this material available to the school authorities in your district.

TOMMY'S FIRST VISIT TO THE DENTIST

"Tommy's First Visit to the Dentist" is a story of a real preschool boy's first visit to a real dentist. It is a 12 page booklet, 5½ by 7 inches in size and exceptionally well illustrated with photographs showing Tommy in a dental office. It is a decided help in educating the preschool children to understand what they can expect on their first visit to the dental office. Single copies sell for 5 cents; 25 copies, $1. Quantity prices on request.

FIRST GRADE DENTAL HEALTH LEAFLETS

These eight leaflets are designed for

primer or first grade use. Educators call them "busy work" or "seat work." Teachers use them in both reading and art classes and children color them with crayolas. The eight subjects covered are: dental care, breakfast, lunch, dinner, vegetables and fruit, milk, washing and sleep. One set of these 8 by 10 inch leaflets sells for 5 cents; 25 sets, 75 cents.

SECOND GRADE EDUCATIONAL LEAFLETS

The six leaflets in this set are designed for first or second grade work. Each lesson is printed on an 8 by 11 inch drawing paper. Wording is fitted to the second grade vocabulary. The text is

scientifically correct. The drawings are simple and artistic. After each lesson is learned, the leaflets can be colored by the children. Like the first grade leaflets mentioned above, this material enables

MILK
Milk helps to build strong teeth.
I drink milk with my meals.
I eat milk on my cereal.
I eat cereal and milk for my breakfast.
I like bread and milk.
My teeth need milk to help make them strong.

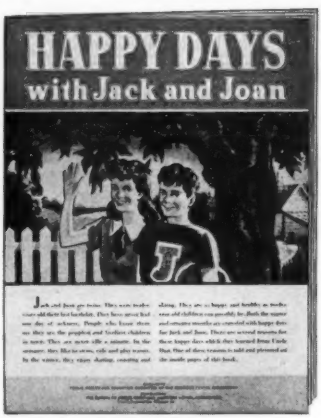
educators to coordinate the teaching of dental health with that of art and of reading. One set of six leaflets sells for 5 cents; 25 sets, 50 cents.

THIRD GRADE EDUCATIONAL LEAFLETS

The six 8 by 11 inch leaflets in this set are designed for children in the third or fourth grade. The lessons are to be studied and questions answered by the children. The drawings may then be colored with crayolas or water colors. On the reverse side of each leaflet is an additional dental health lesson. One set of six leaflets sells for 5 cents; 25 sets, 50 cents.

HAPPY DAYS WITH JACK AND JOAN

"Happy Days with Jack and Joan" is an eight-page booklet, 8½ by 11 inches in size. It is written in story form and de-



signed especially for children between the ages of 9 and 11. It is very practical for children in the fourth and fifth grades. Jack and Joan, 12 year old twins, learn from Uncle Dan that one reason why they are happy and healthy is that they have healthy teeth. Beautifully illustrated, the booklet describes the structure and functions of the teeth, as well as the fundamentals of dental care. The booklet sells for 5 cents; 25 copies, $1. Quantity prices on request.

COUNCIL ON DENTAL THERAPEUTICS

IS FLUORINE A THERAPEUTIC AGENT FOR DENTAL CARIES?

By HAROLD C. HODGE, Ph.D., Rochester, N. Y.

[THE Council has authorized publication of this report as one in the series on pharmacology and therapeutics. —DONALD A. WALLACE, *Secretary.*]

THE recent profusion of scientific papers on the subject of fluorides and dental caries has created a great deal of professional interest. The widespread publicity that certain reports have obtained has brought many patients to the dentist with questions as to what fluorides can do for them. Since few busy dentists have the opportunity to read the extensive literature on fluorides, or even the excellent reviews, this report was prepared, to place before dentists in brief and convenient form the established facts about fluorides and dental caries and to indicate the hypotheses upon which current research is being carried out. This report is not intended to be a detailed review of the literature. Almost no references are given; the data behind conclusions are not cited in most instances, and no attempt is made to give the chronology of the important discoveries. All these things are presented in the existing review. This report is intended to indicate how nearly the key questions about the use of fluorides in caries control can be answered at present.

The first and most important question is: Will fluoride treatments decrease the caries incidence? Two recent clinical reports indicate that, under carefully controlled conditions, topical application of fluoride reduces by about one-half the incidence of new caries. These studies were carried out on school children over a period of about one year and were completely independent, one being made in Boston by Bibby and the other in Indianapolis by Cheyne.

Bibby, at Tufts Dental School, chose a dramatic way to establish adequate control teeth in which the incidence of caries would serve as a basis for evaluating the effects of fluorides on other teeth. It has been repeatedly found that a high correlation of caries attack exists between corresponding teeth in the right and left sides of the same jaw. Therefore, Bibby reasoned, if the teeth in one quadrant of the mouth are treated topically with a fluoride solution, the untreated teeth in the other quadrant of that jaw would furnish an excellent control series. (For Bibby's exact procedure, see *Tufts Dental Outlook,* May 1942.) In ninety children studied for a period of one year, Bibby found a remarkable and consistent reduction in the incidence of new cavities in the fluoride-treated teeth as compared with the untreated teeth in the same jaw. This was true regardless of the location of the treated quadrant; that is, whether upper right, upper left, lower right or lower left quadrant teeth were treated, the untreated quadrant always had one and one-half to three times as many new carious areas. Cheyne, at the University of Indiana, used nineteen children as controls. No fluorides were given them. The twenty-seven children in the experimental group had every tooth treated with a small amount of a

From the Department of Biochemistry and Pharmacology, the University of Rochester School of Medicine and Dentistry.

fluoride solution. (Cheyne's procedure was given in THE JOURNAL, May 1942, page 804.) It is remarkable and probably not a coincidence that these two studies gave nearly identical findings on the usefulness of fluorides in decreasing the number of new lesions. Bibby found sixty-one new carious areas in the untreated quadrants as compared with thirty-three new areas in the fluoride-treated quadrants. Cheyne found that each child in the control group had about six surfaces with new cavities after one year as compared with the fluoride-treated group, in which each child averaged about three surfaces with new cavities. In each case, fluoride treatment reduced the caries incidence by about 50 per cent. While it is not denied that these reports are on relatively small groups of children treated for a limited time, the importance of dental caries control and the success of these two investigators in reducing the caries incidence directs the attention of the dental practitioner to fluorides. At best, it is possible that an inexpensive and potent therapeutic agent against dental caries is at hand, an agent whose effects can be more or less superimposed on any dietary régime. However, until large enough groups of children have been studied under carefully controlled conditions over an adequate period of time, fluoride treatment for dental caries must not be accepted as recommended therapy.

The second answer to the question: Will fluorides inhibit dental caries? comes from studies on the rat. Disregarding the important debate on whether rat caries is comparable to human caries, the fact remains that the laboratory white rat eating coarse cracked corn or rice develops without exception (if this diet is eaten long enough) a broken-down condition of the teeth. It seems now an obvious advantage to give fluorides to rats on a caries-producing diet. However, it was not until 1938 that this experiment was first tried. As a result, Miller, at the University of Chicago, reported that giving a rat approximately 250 parts per million of sodium fluoride in the diet would reduce the incidence of experimental caries by from 60 to 70 per cent. Subsequently, this observation was repeatedly confirmed and extended. At present, data of proved statistical significance establish beyond doubt that fluorides lower the incidence of experimental caries in rats. Many factors in this action have been studied. 1. Fluorides reduce the caries incidence in rats from which the salivary glands have been removed. 2. Fluorides given as calcium compounds exhibit an inhibiting effect, but to a lesser degree, milligram for milligram, than the soluble sodium or potassium compounds. 3. Fluorides may be applied to rat molars and protect these teeth from caries. 4. Continued feeding of fluorides increases the fluoride content of rat enamel and dentin and reduces the caries incidence. 5. The fluoride content of rats' teeth is also increased after continued subcutaneous injection of fluorides. However, this method of fluoride administration was ineffective in reducing caries. These findings illustrate the difficulties in getting a clear picture of the fluoride inhibitory action, but all of them bear out the main contention; namely, that in rats as in human beings, fluoride treatments lower the caries incidence.

The second important question is: What evidence points to a relationship between fluorides and resistance to decay in teeth? A crucial question would seem to be: Is there more fluoride present in the enamel from a sound tooth than in the "sound" enamel from a tooth that has had a carious lesion? Many chemists have analyzed tooth tissues from sound and carious teeth. Generally speaking, no differences have been found. Carious teeth (the undecayed parts) have as much calcium, as much phosphorus, perhaps a little more magnesium, as much water and as much ash as sound teeth.

However, the answer to the question in point: What of the fluoride content? is positive. Armstrong, at the University of Minnesota, found that the enamel from sound teeth contains significantly more fluoride than the enamel from carious teeth. We are apt to disregard minor components. About 35 per cent of enamel is calcium. Obviously, calcium is important. When we read that 0.01 per cent of enamel is fluoride, we are tempted to think "How much difference can 0.01 per cent make?" In reality, still smaller differences are involved. A large, sound molar tooth may have about 0.07 gm. of enamel containing about 0.00007 gm. of fluoride. In a carious molar of the same size, the enamel contains about 0.00004 gm. It is astounding that 0.00003 gm. of fluoride is believed to mean the difference between health and decay.

Those who have studied fluorides and tooth health are inclined to take the chemical analyses seriously. An anecdote about the tiny island of Tristan de Cunha will illustrate the point. For years, dental scientists have discussed the perfect teeth of the island folk who apparently disregard all dietary doctrines of a quart of milk, two vegetables and citrus fruits as the *sine qua non* of good teeth, by living almost exclusively on fish and potatoes. Sognnaes, from the University of Rochester, who studied the islanders' dentition in detail, noted white areas in the enamel which he thought might have been due to fluorides. The island's water supply was not high in fluorides, but the islanders' teeth were. (The currently used water supply contained practically no fluorides. However, it could not be established that the islanders' drinking water has never been fluoride-rich, since more than one source has been used.) Armstrong found more fluoride in the enamel of the teeth of the islanders than in the sound enamel of native Minnesotans. Where did the fluoride come from? Fish is one of the foods richest in fluorides. This is, incidentally, the only probable instance of human fluorosis from food.

What about the water-borne fluorides? Certain deep-well waters are known to contain fluorides. The amount of fluoride is not large—1 or 2 parts per million (1 mg. per liter, or roughly one-one-hundredth grain per quart). Is this trace of fluoride enough to affect the tooth health of those drinking such water? Dean, of the National Institute of Health, and his co-workers give us, in the detailed results of many surveys, a clear answer. The teeth of children who drink fluoride-containing water are healthier than the teeth of children who drink "fluoride-free" water. A few illustrations will stress this point.

1. Along the west shore of Lake Michigan lie the cities of Milwaukee, Sheboygan, West Allis and Green Bay. Milwaukee, Sheboygan and West Allis use Lake Michigan water, which contains only minute amounts of fluorides (0.2 parts per million or less). The children 12 to 14 years old of these cities average 9, 7 and 7, respectively, damaged teeth per child. Underneath Green Bay, at the mouth of the Fox River, is an upfolding of rock making it necessary for the city to get its water supply from deep wells. This water contains 2.3 parts per million of fluorides. Green Bay children average 2+ damaged teeth per child.

2. Among the suburbs of Chicago are five, namely Evanston, Oak Park, Elmhurst, Maywood and Aurora, that are so similar in geographic location, hours of sunshine, rainfall, economic status and population groups that comparisons of tooth health take on added reliability. Fairly large groups of children were examined. The largest group was from Aurora, 633 children; the smallest from Elmhurst, 170. Only 12 to 14 year old children with histories of unbroken exposure to the water supply of each suburb were considered. The water supplies of Evanston and Oak Park are obtained from Lake Michigan; of Elmhurst, May-

wood and Aurora from deep wells. The accompanying table tells the story.

Where the water contained little fluoride, the children averaged about 7 damaged teeth per child. Where the water contained 1 to 2 parts per million of fluorides, the children averaged 2+ damaged teeth per child. Further evidence of the effectiveness of water-borne fluorides comes from the recent reports on conditions in Deaf Smith County (Texas) and elsewhere. The almost complete absence of carious lesions in the upper anterior teeth in children drinking fluoride-containing waters illustrates the ability of fluorides to reduce dental caries. It is hard to escape the conclusion that water-borne fluorides are a powerful factor in reducing the incidence of dental decay.

What is known about fluorides that would explain their power to preserve healthy teeth? Three suggestions can be offered: 1. Just as ingestion of certain vitamins in minute amounts is believed to make possible the development of a tooth structure that is resistant to decay, so, McClendon of the Hahnemann Medical College has suggested, ingestion of a proper amount of fluoride means healthier teeth. 2. By making the tooth tissues more resistant to dissolution in acids, the defense of the tooth would be strengthened. Volker, of the University of Rochester, has shown that the enamel from a rat given fluorides is about half as soluble as the enamel from an untreated rat. Furthermore, he found that shaking powdered enamel in a water solution of fluorides confers the same property of lower solubility upon that enamel. 3. If an agent acts on the oral organisms (which produce the acid that decalcifies teeth) in such a way as to prevent these organisms from forming acids, that agent weakens the forces attacking the tooth. Miller was looking for such an agent when he gave fluorides to his experimental rats. Bibby has shown that certain acid-forming oral bacteria produced only half their capacity of acid when the growth medium contained 200 parts per million of fluorides. A similar reduction in acid formation was also observed when fluorosed tooth tissues were added to the growth medium. Thus, fluorides inhibit acid production by oral bacteria and increase the resistance of tooth tissues to solution by acids. Certainly these actions fall in line with the reduction in caries demonstrated clinically. It is probable that the results of Bibby and Cheyne are due to absorption of fluorides by the surface tissues of the teeth posteruptively and the local activity of the fluorides.

D.M.F. INCIDENCE AND FLUORIDE IN WATER IN FIVE COMMUNITIES

	Evanston	Oak Park	Elmhurst	Maywood	Aurora
Water contains fluorides in parts per million	0.0	0.0	1.8	1.2	1.2
Average number of decayed, missing or filled teeth per child	6.73	7.22	2.52	2.58	2.81

A third important question that naturally arises in considering the use of this new therapeutic agent is: What are the dangers of fluoride therapy? Fluorides have long been known to have toxic properties. However, many useful drugs are highly poisonous when given in amounts greater than the therapeutic dose. It is necessary to find a dose therapeutically valuable, but sufficiently smaller than the toxic dose to assure a safe level of administration. The safe level of effective fluoride therapy is not yet established; that is, at present the amounts of fluoride that can be tolerated by the

body with complete freedom from noxious sequelae and assure the desired inhibition of dental caries are not accurately known. Since a reduction of caries is observed in children whose drinking water contains only traces of fluorides (1 part per million), which give no indication of systemic toxic actions under the general conditions of nutrition and the climate of the midwest over a period of years, it is probable that a safe, effective treatment can be found. The outlook is hopeful.

To point out the kinds of toxic reactions to large oral doses of soluble fluorides, the following symptoms are listed in order of their frequency of occurrence: vomiting, abdominal pain, diarrhea, convulsions, weakness and collapse. Thirty-four fatalities have been reported from acute fluoride poisoning. In animals, the minimum lethal dose is about 50 mg. per kilogram (about one-half grain per pound) of body weight. Chronic poisoning by small amounts taken over long periods sometimes has been observed; for example, from powdered fluoride mineral in cryolite plants. These chronic toxic symptoms show up most prominently in (a) deformities of the bones, such as exostoses, spontaneous fractures, metatastic calcification and a stiff, painful gait, and (b) the blood changes of anemia, in which a 5 to 10 per cent decrease in hemoglobin accompanies a 25 per cent reduction in the red blood cell count. One of the best known actions of fluorides is the enzyme inhibiting action (bone phosphatase, trypsin, ptyalin and others), which probably is an important component of its caries-reducing property. The body handles fluorides in small amounts much as it does chlorides or bromides. They are rapidly absorbed, widely distributed and excreted mostly via the urine. Fluorides are stored to a marked degree compared to chlorides and bromides; the site of storage being principally in the skeleton. Small amounts of fluoride may be secreted in the milk. The saliva contains traces of an intravenously given dose. Fluorides apparently do not pass through the placenta in more than minute amounts.

The toxic effect of most interest to the dental profession is "mottled enamel," the disfiguring lesion which was named and studied by G. V. Black and F. S. McKay. In mild fluorosis, the teeth show only faint milky areas. In more severe fluorosis, the enamel becomes pitted, the pits may coalesce to produce ribbing and the surface of the enamel is rough and severely hypoplastic. These areas become pigmented, ranging in color from pastel tan to brown and even to black. The marked hypoplasia led Black to expect a high incidence of caries. When his examinations of the teeth of persons with mottled enamel revealed few such cases, he wrote, perhaps reflecting his surprise, "The number of carious cavities is fewer than elsewhere." It is curious that this observation lay almost unnoticed for twenty years. However, the fear of producing mottling in the enamel is a deterrent of the first magnitude to those who are unfamiliar with the evidence that a striking quantitative relationship exists between the fluoride concentration in the drinking water and the degree of clinical effect. One important fact should be borne in mind: Mottled enamel cannot be produced in fully formed and erupted teeth. Thus, the topical application of fluorides as used by Bibby and Cheyne cannot possibly produce mottling of the enamel in the treated teeth. Mottling is the end-product of a series of degenerative changes in the ameloblasts. Fluorides transform these cells to a squamous-cell type that apparently has lost the normal function of ameloblasts. This degeneration can only occur in forming teeth. However, fairly low levels of fluorine in drinking water are capable of producing mild mottling. Two parts per million will give areas detectable on careful examination. On the other hand, children whose drinking water contains 1 part per

million occasionally evidence fluorosis so mild that esthetically it is insignificant. The children, the parents and the dentists may be unaware of the mottling.

SUMMARY

1. *Clinical Studies.*—Applications of fluorides in two clinical tests have, over the period of a year, effected a reduction by one-half of the incidence of new caries in children. The teeth of children whose drinking water contains 1 to 2 parts per million of fluorides have a much lower caries incidence (one-third to one-half less caries) than is found in children drinking fluoride-free water.

2. *Laboratory Studies.*—Experimental rat caries is materially decreased by fluorides in the diet or in the drinking water. Sound enamel from non-carious teeth contains more fluorine than does sound enamel from carious teeth. Fluorides inhibit acid production by oral bacteria and decrease the solubility of enamel and dentin in acids.

3. *Toxic Properties of Fluorides.*—The safe level of oral fluoride administration which will give a maximum reduction in caries incidence is not known. No significant toxic symptoms occur in children whose drinking water contains 1 part per million of fluorides, although a marked reduction in caries incidence is observed. The ingestion of fluorides in excess of the permissible maximum causes mottling of the enamel in forming teeth. Mottling of enamel in fully formed, erupted teeth cannot be produced by fluorides.*

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*The author acknowledges the helpful criticisms of B. G. Bibby, H. T. Dean, H. B. McCauley and J. F. Volker.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

DENTIFRICES*

Scott's Tooth Powder.—Composition: See Stevens-Wiley Tooth Powder (A.D.R. Ed. 8, p. 113).

Manufactured by the Stevens-Wiley Mfg. Co., Inc., Philadelphia, Pa. Distributed by H. E. Scott Sales Co., Chicago Heights, Ill.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information regarding the rules and work of the Council will be sent on request.

DONALD A. WALLACE, *Secretary.*

*A.D.R. Ed. 8, p. 102.

COUNCIL ON DENTAL HEALTH

INASMUCH as the responsibilities and duties of the Public Health and Education Committee and the National Health Program Committee were basically the same, and inasmuch as their activities in many instances overlapped, the House of Delegates of the American Dental Association, at the St. Louis meeting, approved a recommendation to discontinue both committees and establish a council on dental health.

The duties of the Council on Dental Health, which is a standing committee, are as follows:

1. To study the need and develop plans and programs for the provision of more nearly adequate dental care for the public and to study and make recommendations concerning any other plans or programs developed to promote the dental health of the public.

2. To assist constituent and component societies in the development of dental health policies and programs within their jurisdiction.

3. To establish and maintain effective relations with local, state, federal and any other responsible agencies, such as industrial organizations, in the promotion, administration and advancement of dental health.

4. To supervise the activities of the Bureau of Public Relations and to formulate procedures and policies that will tend to advance the work of the Bureau.

5. To correlate its activities with that of the other standing committees of the American Dental Association whenever situations of common concern present themselves.

The members of the new council are:

Emory W. Morris
Harold J. Noyes
Walter A. Wilson
Frank C. Cady
Leroy M. S. Miner
Hugo M. Kulstad
Leon R. Kramer
L. T. Hunt
Leo J. Schoeny

Lon W. Morrey, director of the Bureau of Public Relations, ex-officio member.

Howard C. Miller is the contact representative from the Board of Trustees.

In view of the new council's responsibilities, J. Ben Robinson, President of the American Dental Association, called a meeting of its members at the Palmer House, Chicago, Ill., October 3 and 4.

At the request of Dr. Robinson, who unfortunately was unable to attend because of pressing business in Washington, Emory W. Morris served as temporary chairman. The first order of business was to elect Dr. Morris and Dr. Morrey chairman and secretary, respectively.

In accepting his new duties, Dr. Morris emphasized the great responsibility that must be carried by each of the council's members and quoted Dr. Robinson to the effect that

> . . . the creation of this council with the authority which it possesses is perhaps the most significant step taken by the American Dental Association in a long time. It represents a consciousness of the House of Delegates that the American Dental Association must assume larger responsibilities with respect to dental health and that our official representatives must study and appraise the over-all picture of dental health needs and services. . . . The over-all problem will bring into the scope of your [the Council's] deliberations the horizontal levels of dental health activities—national, state, county and community—as well as the vertical development of projects, devices, programs, etc., that have resulted from experiment and experience.

A major portion of the first day's meeting was devoted to organization purposes. After fully exploring and discussing the problems confronting the

council, the members felt that their duties might well be grouped into two classes, those of an acute nature being termed the immediate problems and those of a less acute nature being termed the long range program or problems.

Under the long range heading were listed such problems as the establishment of aims and purposes of the council, a caries control program and, as Dr. Robinson pointed out, the establishment of dentistry more firmly in federal, state and community health programs.

One of the important duties of the council will be to study and appraise the present social trends as they affect health service, so that it may be able to predict future developments and guide the American Dental Association into its proper position in postwar planning and postwar developments.

Under the heading of immediate problems, the council listed the guidance of the activities of the Bureau of Public Relations, the necessity of including a dental health program in the High School Victory Program now being undertaken by the U. S. Office of Education, the establishment of a bureau of dental services in the U. S. Public Health Service and the establishment of closer contacts with the Social Security Board and Farm Security Administration in an effort to improve the dental phase of their relief programs.

The necessity of establishing closer and more workable relations with the federal and state agencies was emphasized by Dr. Robinson in one paragraph of his letter to the council:

> It seems to me that the basic purpose of the council is to make an over-all appraisal of the dental health situation as to both recognized needs and the existing agencies designed to meet those needs, to suggest means of correlating these needs and services and to stimulate greater effort in the achievement of our goal of better oral health for all the people.

Harlan H. Horner, secretary of the Council on Dental Education; Samuel R. Lewis, secretary of the Committee on Legislation, and Melvin L. Dollar, secretary of the Committee on Economics, outlined the purposes, ambitions and activities of the committees which they represent. The duties of all three committees are closely associated with those of the new Council on Dental Health, and the council hopes that the activities of all four committees can be better correlated in the interest of the Association.

The chairman, Dr. Morris, appointed three subcommittees and assigned the duties of each as follows:

1. Executive Committee.

Members: Emory W. Morris, Leroy M. S. Miner, Frank C. Cady and Lon W. Morrey.

Duties:

a. Formulate aims, purposes and policies.

b. Consider United States Public Health Service reorganization bill.

c. Determine legislative policies.

d. Make official contacts with such national groups as may be desired.

e. Act as ad interim committee for the Council on Dental Health.

f. Consider and assign projects for the program of the council.

g. Arrange agenda for council meetings.

2. Health Program Committee.

Members: Leroy M. S. Miner, chairman; Leon R. Kramer, Harold J. Noyes and L. T. Hunt.

Duties:

a. Victory Corps Program (high school).

b. Industrial health programs.

c. Caries control program.

d. Federal programs.

e. Programs of state societies and state departments of health and such other duties as may develop.

3. Health Education Committee.

Members: Frank C. Cady, chairman; Leo J. Schoeny, W. A. Wilson and Hugo M. Kulstad.

Duties:

a. Supervise activities of the Bureau of Public Relations.

b. Prepare lay and professional educational materials essential for programs initiated by Health Program Committee.

c. Develop Children's Memorial Award Plan.

Probably the most pressing of the immediate problems confronting the council is the establishment of a bureau of dental services in the U. S. Public Health Service. September 29, Congressman Bulwinkle, of North Carolina, chairman of the Subcommittee of the Interstate Commerce Committee of the House, introduced a bill, H.R. 7616, which, if it becomes a law, will permit a reorganization of the U. S. Public Health Service. It became the duty of the new Council on Dental Health to formulate a statement regarding the needs and advisability of establishing a bureau of dental services in the reorganization. The council formulated the following statement, which was forwarded to J. Ben Robinson, President of the Association, and Sterling V. Mead, chairman of the American Dental Association Committee on Legislation:

A STATEMENT BY THE AMERICAN DENTAL ASSOCIATION, COUNCIL ON DENTAL HEALTH, SUPPORTING THE RECOMMENDATION OF THE AMERICAN DENTAL ASSOCIATION HOUSE OF DELEGATES TO CREATE A SEPARATE DIVISION FOR DENTISTRY IN THE UNITED STATES PUBLIC HEALTH SERVICE

That dental disease is the most prevalent disease of mankind has been verified by surveys of large population groups, most of which have been made by the United States Public Health Service and the American Dental Association. This fact has also been verified by the physical findings in examinations of the men selected for military service. In October 1941, President Roosevelt[1] released statistics collected by Selective Service Headquarters showing that approximately 1,000,000, or 50 per cent of the first 2,000,000 selectees examined for World War II, were disqualified for army service because of physical, mental or educational conditions. In the 900,000 men disqualified because of physical conditions, the Selective Service report itemized as the first three causes for rejection:

Dental defects, 188,000 cases, (20.9 per cent).

Defective eyes, 123,000 cases, (13.7 per cent).

Cardiovascular diseases, 96,000 cases, (10.6 per cent).

Dental disease topped the list of disqualifying diseases.

For years, the American Dental Association has studied ways and means of improving the dental health of the American people. The Council on Dental Health of the American Dental Association has, as its major responsibility, the development of plans and programs that will provide the public with adequate dental care.

The American Dental Association feels that, considering the magnitude of the problem, the United States Public Health Service has not adequately supported programs for the provision of dental care for the public, nor has it taken the leadership in the field of dental health as it properly has in other fields of health service. It is the feeling of the American Dental Association that this condition exists, not through lack of interest on the part of the United States Public Health Service, but rather because of the limitations imposed upon the planning and execution of dental programs by medical officers, whose medical training and experience does not provide them with the technical and practical knowledge demanded in this special field. This is evidenced by the fact that in its reorganization plan (a bill, H.R. 7616, for the organization and functions of the U. S. Public Health Service), it has failed to make adequate provision for a suitable

administrative unit in the United States Public Health Service, which is absolutely essential to the development of a national dental health program.

Paul V. McNutt, Federal Security Administrator,[2] in his 1941 Child Health Day address, stated:

> A boy with a toothache has traditionally been merely a comic figure. But surely he has ceased to be a butt for jokes. Dental disease is no laughing matter; it is no matter for apathy or ignorance.

Professor Ernest A. Hooton,[3] of Harvard University, has stated:

> If dentistry is to survive as a health service, there must of necessity be a change of emphasis, a revision of principles and objectives all along the line. . . . The dental profession has been for too long a time a neglected and orphaned child of medicine. While millions have been lavished upon medical schools and hospitals and upon medical research, almost nothing has been allotted for these purposes to dentistry.

Thomas Parran, M.D., Surgeon General of the United States Public Health Service,[4] stated, in an address delivered before the American Dental Association in 1937, that "in every state health department there should be a dental division and this division should be charged with the responsibility of the development of this program."

For many years, the United States Public Health Service has taken the initiative in recommending the establishment of separate divisions or bureaus of dentistry directed by a dentist, in the state departments of health. To date, the majority of the states have such separate dental divisions or bureaus, each functioning under the direction of a dentist. Furthermore, for several years, the United States Public Health Service has provided funds for the education of dentists who hold administrative positions in these state health departments. These dentists have received their education in accredited schools of public health. Their training has been identical with that of medical health officers who assume similar administrative duties in their particular field. Also, for many years, the United States Public Health Service has provided funds to the various state health departments for the development of state dental health programs.

Notwithstanding the fact that the United States Public Health Service has recommended the creation of separate bureaus or divisions of dentistry in the state health departments, it has neglected to make similar provision in its own reorganization bill (H.R. 7616) for the creation of a separate division or bureau to administer a dental health program on a national scale.

For years, the American Dental Association has recognized the fact that the dental program in the United States Public Health Service has been inadequate. At the Annual Meeting of the American Dental Association in October 1941, the house of Delegates of the American Dental Association adopted the following recommendation[5]:

> In the course of its work with federal agencies, the National Health Program Committee has repeatedly been confronted with the inadequacy of the dental program of the United States Public Health Service. The National Health Program Committee believes that the creation of a separate division for dentistry in the United States Public Health Service, with a dentist of the rank of assistant surgeon general at its head, would provide leadership in this department of government for the improvement of the dental health of the nation.

Following the approval of this recommendation, the officers of the American Dental Association conferred with the Surgeon General of the United States Public Health Service, at which time the Surgeon General intimated that he would look with favor on the creation in the United States Public Health Service of a dental division or bureau headed by an assistant surgeon general who was a dentist. Furthermore, the Surgeon General stated that legislation was being pre-

pared at that time to reorganize the United States Public Health Service and advised the American Dental Association officials that the proposal of the American Dental Association to establish a bureau of dentistry in the United States Public Health Service could properly be a part of that legislation.

The Congress has seen fit to pass a bill creating the position of Chief of Dental Service in the United States Army with the title of brigadier general, who serves under the immediate supervision of the Surgeon General of the Army.

The American Dental Association is firmly of the opinion that in the interest of the public's health, a similar position is needed in the United States Public Health Service. Therefore, in the interests of the health and welfare of the American people, the American Dental Association urgently requests that the present bill providing for the reorganization of the United States Public Health Service be amended to provide for a Bureau of Dental Services administered by a commissioned dental officer detailed by the Surgeon General from the regular corps and, while so detailed, the dental officer shall be an assistant Surgeon General and shall have the same grade and shall receive the same pay and allowances as the assistant to the Surgeon General.

COUNCIL ON DENTAL HEALTH.
EMORY W. MORRIS, *Chairman.*

Because of the urgency for getting many of its activities under way, the council will meet again on December 12 and 13.

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HIGH SCHOOL VICTORY CORPS

THE Council on Dental Health of the American Dental Association is sponsoring a movement to have dental health incorporated in the recently created nation wide High School Victory Corps Program.

The High School Victory Corps is open to all of the 6½ million students in the nation's 28,000 public and private secondary schools. It is established to give every high school student in the United States the opportunity to take a definite place in the national war effort through a voluntary enrollment plan. The Corps is headed by Capt. Eddie Rickenbacker, aviation leader and flying ace of the first World War.

The objectives to be pursued, both inside and outside of the classroom, will consist of "guidance of youth into critical services and occupations; wartime citizenship training to insure better understanding of the war, its meaning, progress and problems; physical fitness; voluntary military drill for selected boys; competence in science and mathematics; pre-flight training in aeronautics for those preparing for air service, including training for essential civilian activities."

The plans do not provide specifically for a dental health program, although in all probability, dental health will be included under "physical fitness."

The Council on Dental Health of the American Dental Association feels very strongly that a program of dental health should be definitely and specifically provided for, and Chairman Morris of the Council has already contacted Mr. John W. Studebaker, United States Education Commissioner.

COMMITTEE ON LEGISLATION

RECENT AMENDMENTS TO THE SOLDIERS' AND SAILORS' CIVIL RELIEF ACT

OCTOBER 6, President Roosevelt signed H.R. 7164, a bill providing numerous amendments to the Soldiers' and Sailors' Civil Relief Act of 1940. The purpose of the Civil Relief Act is to free persons in military service from harassment and injury to their civil rights during their term of military service.

During the two years that the act has been in effect, numerous defects and inadequacies have become apparent, and the present amendments are designed to remedy as many of these as possible. In the words of the Senate Committee on Military Affairs,

> The purpose of the reported bill is to make available additional and further relief and benefits to persons in the military and naval forces, and, in some instances where there has been doubt as to whether particular transactions or proceedings are within the scope of the Civil Relief Act, a new section or language has been added for the purpose of clarification only and to carry out the original intent of Congress, but with no intent to exclude from the provisions of the act any transaction or proceeding now included.

A summary of the act in its original form was published in the March 1942 issue of THE JOURNAL, and this article is intended to summarize the most important provision of the recent amendments and show how dentists now in the service, or those who will be called in the future, will be benefited by the changes.

PERSONS COVERED BY AMENDMENTS

As far as possible, the present amendments are made applicable to persons already in the service. The extended benefits in regard to leases on offices, protection of insurance and tax sales are all apparently made available to persons in the service unless there is some reason under the provisions of the act why this cannot be so. In most cases, unless some court action has been completed prior to the enactment of the amendments, there will be no such reason. Otherwise, the act and amendments apply to all persons in the Armed Forces, persons ordered to report for induction or members of the Enlisted Reserve Corps ordered to active duty. The amendments also provide that the act shall apply to persons who serve in the armed forces of our allies and who, immediately prior to such service, were citizens of the United States, unless they are dishonorably discharged or it appears that they do not intend to resume United States citizenship.

HOME AND OFFICE LEASES

Probably the most important provision of the amendment, as far as the dental profession is concerned, is that which deals with office leases. Under the old law, relief from leases on property used as a dwelling place was provided, but no provision was made for relief from obligations in connection with premises used as offices. The recent amendments remedy this defect by providing that any lease covering premises occupied for dwelling, professional business, agricultural or similar purposes may be terminated by notice in writing delivered to the lessor or his agent at any time following the date of the beginning of the period of military service. Termination of any such lease providing for monthly payment of rent shall not be effective until thirty days after the first date on which the next rental payment is due and payable, subsequently to the date when such notice is delivered or mailed.

If the rent is not paid monthly, termination shall be effected on the last day

of the month following the month in which such notice is delivered or mailed and, in such case, any unpaid rental for a period preceding termination shall be proratably computed and any rental paid in advance for a period succeeding termination shall be refunded by the lessor (or his assignee).

This amendment also provides that any person who shall knowingly seize or hold any of the property of a person who has lawfully terminated a lease covered by this section or interfere with the removal of property shall be guilty of a misdemeanor and shall be punished by imprisonment not to exceed one year or by a fine not to exceed $1,000, or both.

INSURANCE POLICIES ASSIGNED AS SECURITY

The recent amendments add to the act a provision dealing with cases in which a person in the armed forces has assigned an insurance policy to another person as security for payment of an obligation. The new section provides that the holder of the policy cannot exercise any right or option in regard to the policy during the period of service or one year thereafter, without the written consent of the insured, given while premiums are due and unpaid or upon the death of the insured, unless the consent of a court is obtained. This section was needed because of the fact that many loans are made on the cash value of life insurance policies and that these policies may be converted to cash value upon default of loan without court action. In the absence of this amendment, a person in military service could lose his policy at a time when it was of increased value to him because of the hazardous nature of military service.

PERIODS OF LIMITATION

The original act provided that the right of any person to sue or be sued should not be affected by the period of military service. In other words, the period of service should not be included in determining whether a person has begun suit within the period specified by various laws. The amendments reenact this provision and extend it to include not only any period limited by law, but also any period limited by a rule or regulation of a board, bureau, commission, department or other agency of government.

RATE OF INTEREST

The recent amendments add a section which provides that no obligation bearing interest at a rate in excess of 6 per cent per year incurred by a person in military service prior to his entry into service shall, during any part of the period which occurs after the date of these amendments (October 6, 1942), bear interest in excess of 6 per cent, unless, in the opinion of the court, upon application of the obligee, the ability of the person in military service to pay such interest is not materially affected by reason of such service.

REPOSSESSION OF MOTOR VEHICLES

The section in the original act that permits a proceeding to resume possession of a motor vehicle unless 50 per cent or more of the purchase price has been paid is repealed by these amendments. In its place, a section is added which permits a court to allow a proceeding to foreclose a mortgage upon personal property to proceed provided it will not impose undue hardship upon the dependents of a person in military service. If the proceeding is permitted to continue, the court is required to appoint three disinterested persons to appraise the property, and on the basis of the report of the appraiser, the court may order such sum, if any, as may be just, paid to the person in military service or his dependent, as a condition of foreclosing the mortgage, resuming possession of the property or rescinding or terminating the contract.

STORAGE OF GOODS

A new section, Section 305 (2), is

added to the act, by the amendments, for the purpose of prohibiting a person from foreclosing or enforcing a law for storage of household goods, furniture or personal effects of a person in military service during such service and for three months thereafter, except upon an order previously granted by a court upon application made therefor. In such a case, the court may stay the proceedings or make such disposition of the case as may be equitable.

INSURANCE

The section relating to insurance is considerably revised by the recent amendments to the act. Perhaps the most important change is the increase from $5,000 to $10,000 as the amount of insurance which the person in military service may have protected by the United States. Payment of premiums and interest upon this amount of insurance is guaranteed by the United States for the period of military service and for two years thereafter, if all requirements are complied with. If the amount so guaranteed is not paid to the insurer prior to the expiration of the period of insurance protection under this article, the amount then due shall be treated by the insurer as a policy loan. If, at the expiration of the period, the cash surrender value is less than the amount then due, the policy shall then cease and terminate, and the United States shall pay the insurer the difference between such amount and the cash surrender value. The amount paid by the United States will then become a debt due to the United States by the insured.

TAXES

The 1942 amendments extend the protection of the act to taxes on personal property, money and credits in addition to taxes on real property, which were the only type included in the original act. They also include the word "professional" in the uses to which the property may have been devoted in order to be covered by the act. Others are dwelling, business or agricultural purposes.

No sale of property for payment of taxes may be made except on leave of the court on application of the collector of taxes. The court may stay such proceedings or sale for a period extending not more than six months after the termination of the period of military service unless, in its opinion, the person's ability to pay is not materially affected by reason of such service.

FURTHER RELIEF

The recent amendments add a new section at the end of the act, a "catch-all" provision which permits any person at any time during his period of military service or within six months thereafter, to apply to a court for relief in respect to any obligation or liability incurred by such person prior to his period of military service or with respect to any tax or assessment whether falling due prior to or during his period of military service. The court is given power to postpone enforcement of the obligation, liability, tax or assessment for the period of military service, or longer if the court deems it just.

COMMITTEE ON LEGISLATION.
SAMUEL R. LEWIS, *Secretary*.

COMMITTEE ON ECONOMICS

A STUDY OF THE RISING COSTS OF CONDUCTING A DENTAL PRACTICE
(PART II)

By R. M. WALLS,* D.D.S., and M. L. DOLLAR†

IN the September issue of THE JOURNAL, the Committee on Economics published the first section of its report on the study of the rising costs of conducting a dental practice. Since this first report described in some detail the purpose, scope and method of the study, it will not be necessary, in presenting this second section, to repeat this detailed statement. However, a brief review may aid the reader in recalling the substance of the earlier report.

The study was undertaken by the committee in order to obtain information regarding the effects of rapidly rising prices during the period 1939-1941 on the cost of conducting a dental practice. Questionnaires were sent out to a carefully selected sample of 5,000 dentists. Replies were received from 1,312 dentists. Fortunately, the replies were so distributed as to be representative of the entire profession with respect to the factors that it was possible to control.

TABLE 1.—AVERAGE WAGE RECEIVED BY EMPLOYES IN DENTAL OFFICE BY TYPE FOR THE YEARS 1939, 1940, and 1941; ACCORDING TO GEOGRAPHIC AREA

Geographic Area	Dental Assistants			Oral Hygienists			Dental Technicians			Assistant Licensed Dentists		
	1939	1940	1941	1939	1940	1941	1939	1940	1941	1939	1940	1941
Total United States	$67	$73	$78	$105	$111	$119	$120	$129	$141	$211	$223	$237
New England	68	74	79	103	112	120	125	125	142	.....	.....	.....
Middle Atlantic	73	79	85	105	110	114	222	222*	229	179	186	190
East North Central	64	71	76	94	100	102	128	136	146	247	258	287
West North Central	56	60	64	88	91	95	60	65	70	206	224	224
South Atlantic	68	71	78	125	130	156	103	105	123	204	204	216
East South Central	49	54	60	.....	.....	.....	.....	.....	.....	.....	.....	.....
West South Central	63	68	75	.....	.....	.....	43	54	64	175	236	262
Mountain	50	54	59	125	125	130	102	114	119	.....	.....	.....
Pacific	79	86	93	112	121	141	125	139	147	200	211	224

*The number of dental technicians reported on from this area was too small to be considered representative.

It will be recalled that in the section of the report already published, an analysis was presented of the rental rates for dental offices. Office rent represents one of the major costs of operating the average practice, and, in many cases, it is the largest single item on the cost side of the ledger. A second major cost is that of the salaries of employes in the dentists' offices. This item is particularly important since it tends to fluctuate more rapidly, perhaps, than any other item of cost. This report will deal largely

*Chairman of the Committee on Economics.
†Secretary of the Committee on Economics.

TABLE 2.—AVERAGE WAGE RECEIVED BY EMPLOYES IN DENTAL OFFICE BY TYPE FOR THE YEARS 1939, 1940 AND 1941; ACCORDING TO SIZE OF COMMUNITY

Size of Community	Dental Assistants			Oral Hygienists			Dental Technicians			Assistant Licensed Dentist		
	1939	1940	1941	1939	1940	1941	1939	1940	1941	1939	1940	1941
Total United States	$ 66.80	$ 72.66	$ 78.29	$ 104.69	$ 111.49	$ 119.12	$ 120.23	$ 128.71	$ 140.99	$ 210.71	$ 222.68	$ 237.05
Under 1,000	48.61	54.57	59.14	125.00	125.00	168.75	—	—	—	—	—	—
1,000— 2,499	41.47	45.57	49.21	—	—	—	—	—	—	—	—	—
2,500— 4,999	54.58	59.54	64.22	72.50	81.56	97.87	103.75	103.75	118.02	250.00	250.00	—
5,000— 9,999	53.26	58.32	64.11	—	—	—	42.50	46.40	56.67	—	—	—
10,000— 24,999	61.17	65.66	69.94	105.00	112.00	118.79	86.50	102.50	113.75	247.50	264.01	268.12
25,000— 49,999	65.00	72.53	77.77	94.38	105.00	117.39	104.38	113.51	126.56	175.00	175.00	175.00
50,000— 99,999	69.69	73.79	79.60	130.63	137.98	145.33	250.00*	250.00	250.00	175.00	236.35	262.50
100,000—499,999	69.13	75.50	81.61	102.05	109.70	115.28	128.93	139.52	150.58	135.63	141.57	151.74
50,000 and over	77.95	84.75	91.75	102.25	106.08	110.17	141.14	143.71	151.72	227.22	235.42	256.32

*The number of dental technicians reported on from this area was too small to be considered representative.

TABLE 3.—WAGE RATES IN 1940 AND 1941 COMPARED WITH WAGE RATES IN 1939 ACCORDING TO GEOGRAPHIC AREA*

Geographic Area	Wages in 1940 Compared with Wages in 1939			Wages in 1941 Compared with Wages in 1939		
	Employes Receiving Wage Increases Per Cent	Average Increase in Wages of All Employes Per Cent	Average Increase for Employes Receiving Raise in Pay Per Cent	Employes Receiving Wage Increases Per Cent	Average Increase in Wages of All Employes Per Cent	Average Increase for Employes Receiving Raise in Pay Per Cent
Total United States	46.9	8.5	18.1	62.9	16.9	26.8
New England	46.0	7.9	17.2	51.0	15.0	29.4
Middle Atlantic	47.8	7.9	16.4	59.8	14.8	24.7
East North Central	56.5	10.5	18.6	69.7	19.1	27.4
West North Central	42.5	7.9	18.5	51.8	14.7	28.0
South Atlantic	28.4	5.2	18.5	55.6	15.9	26.8
East South Central	55.0	9.7	17.7	63.2	21.2	33.5
West South Central	34.6	9.7	23.9	64.7	19.7	27.9
Mountain	34.6	9.0	26.1	61.5	16.9	27.5
Pacific	52.7	8.5	16.2	67.0	17.0	25.4

*Percentage of employes receiving wage increases; average percentage increase for all employes; average percentage increase where employe received a raise in pay.

with an analysis of the fluctuation in the matter of salaries. However, consideration will also be given to laboratory costs and the costs of supplies and of materials.

Credit was given in the first report to the many dentists who cooperated to make this study possible. It is fitting at this point to express the appreciation of the committee

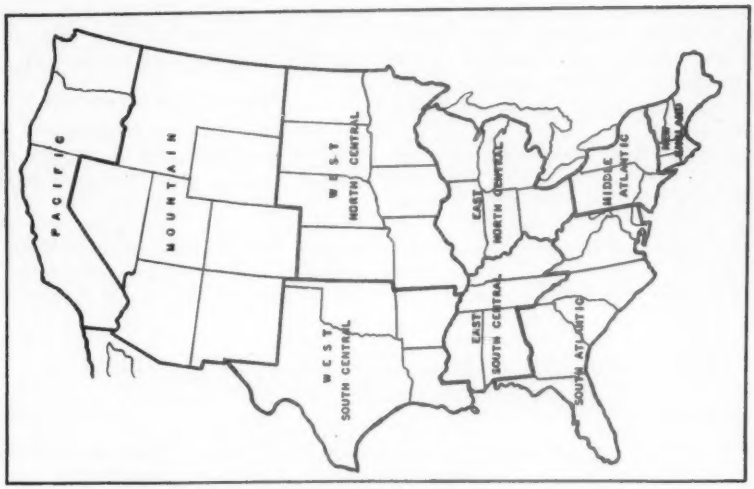


Fig. 1.—United States divided into nine geographic areas.

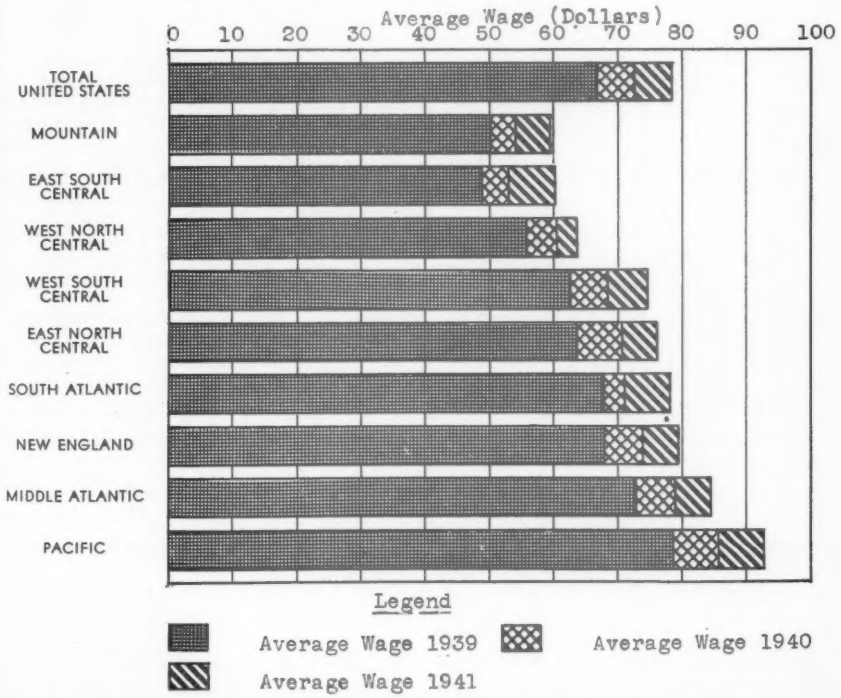


Fig. 2.—Comparison of average monthly wage rates for dental assistants for the years 1939, 1940 and 1941 by geographic area. (Geographic areas arranged in sequence according to average wage rates in 1939).

to the Dental Laboratories Institute of America and to various members of dental supply houses who aided in gathering data on the price trends for laboratory service and for dental supplies during the period under consideration.

Prices began their marked upward trend about 1939. Consequently, that year was selected as a basis for comparison of costs in 1940 and 1941. In the analysis of wage rates that follows, all increases in wage rates are measured in terms of the wage rates existing in 1939. Since prices of most commodities and rental rates have been frozen by order of the Federal Government since March 1942, little change will have taken place in the costs of conducting a dental practice since the end of 1941.

Since frequent reference is made in the tables and graphs to the "nine major geographic areas in the United States," the map of the United States showing these divisions, which was published in the first section of the report, is repeated here (Fig. 1) for convenience in following the analysis.

TYPES OF DENTAL EMPLOYES

From the 1,206 questionnaires used in the study, it was found that 66 per cent of the dentists reporting had one or more employes in their offices during the year 1941. It follows, of course, that 34 per cent of the dentists operate their offices without any assistance. Fifty-seven per cent of the dentists reported having but one employe, while 9 per cent reported having two or more employes.

The four types of employes ordinarily found in the dental office are included in the study; namely, dental assistants, oral hygienists, dental technicians or mechanics and assistant licensed dentists. The dental assistants are by far the most numerous, making up approximately 86 per cent of all em-

TABLE 4.—WAGE RATES IN 1940 AND 1941 COMPARED WITH WAGE RATES IN 1939 ACCORDING TO SIZE OF COMMUNITY*

Size of Community	Wages in 1940 Compared with Wages in 1939			Wages in 1941 Compared with Wages in 1939		
	Employes Receiving Wage Increases Per Cent	Average Increase in Wages of All Employes Per Cent	Average Increase for Employes Receiving Raise in Pay Per Cent	Employes Receiving Wage Increases Per Cent	Average Increase in Wages of All Employes Per Cent	Average Increase for Employes Receiving Raise in Pay Per Cent
Total United States	46.9	8.5	18.1	62.9	16.9	26.8
Under 1,000	45.5	10.5	23.0	54.5	23.4	32.2
1,000— 2,499	47.1	9.8	20.8	67.6	18.2	26.9
2,500— 4,999	35.5	8.7	22.9	63.6	19.1	29.0
5,000— 9,999	46.2	10.3	21.6	64.4	20.6	32.0
10,000— 24,999	55.8	7.8	16.8	59.0	14.8	25.0
25,000— 49,999	45.4	10.3	16.9	61.3	20.0	29.9
50,000— 99,999	37.9	5.8	14.9	59.0	13.2	22.4
100,000—499,999	41.1	8.7	21.2	61.8	16.7	27.1
500,000 and over	50.9	8.4	16.4	63.6	16.6	26.1

*Percentage of employes receiving wage increases; average percentage increase for all employes; average percentage increase where employe received a raise in pay.

ployes. Oral hygienists account for 6 per cent, dental technicians, 5 per cent, and assistant dentists, 3 per cent, of all employes in dental offices.

AVERAGE WAGE OF EMPLOYES

The salary rate of the dental assistant is ordinarily lower than that of the hygienist, technician or assistant dentist. However, in considering the cost of operating the average dental office, the salary of the dental assistant is more important than that of the other types of employes, since dental assistants make up such a large percentage of all employes. Consequently, more attention is given to this item of cost in this study.

In the year 1939, the average wage paid to the dental assistant in the United States was $67 per month. This was increased to $73 per month during the year 1940 and to $78 per month during the year 1941. (Table 1; Figs. 2 and 3.) This represents an increase in the average wage of 8.9 per cent in 1940 and 16.4 per cent in 1941. Comparison of the wage rates for various sections of the country shows that the east south central states had the lowest rate in 1939, the average wage for dental assistants being $49 per month. This was increased to $60 a month in 1941. The Pacific states showed the highest rate in 1939, paying an average wage of $79 per month. This was increased in 1941 to $93 a month. Comparison of wage rates in communities of various sizes shows, as would be expected, a close correlation between the size of the community and the average wage rate. (Table 2.) The lowest wage rate in 1939 was paid in communities having a population of from 1,000 to 2,499 persons, the average wage being $41.47 a month. This was increased to $49.21 a month in 1941. The average monthly wage

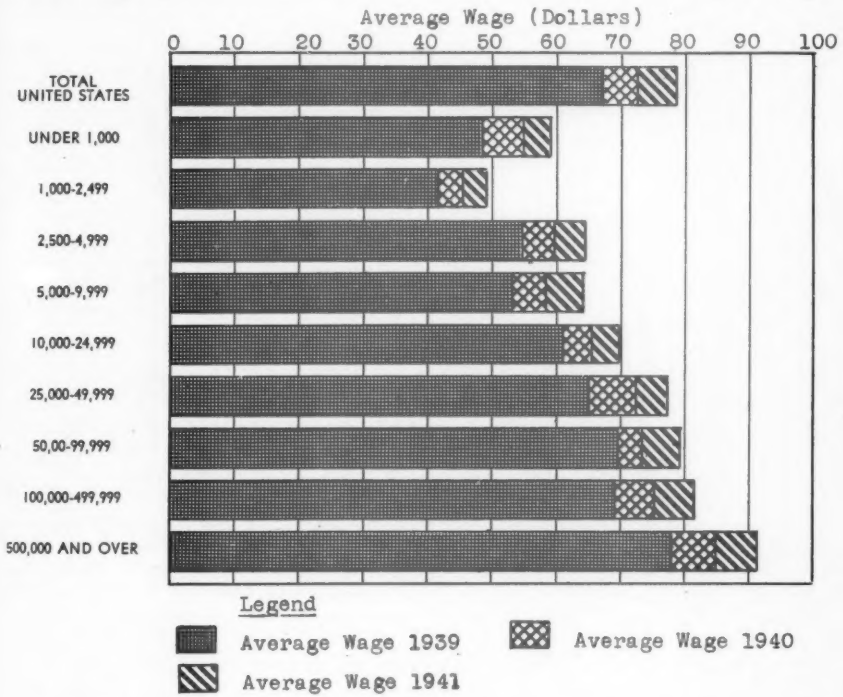


Fig. 3.—Comparison of average monthly wage rates for dental assistants for the years 1939, 1940 and 1941 according to size of community.

gradually increases with each increase in the size of the community, reaching an average in 1939 of $77.95 a month in cities of more than 500,000 population. In 1941, the average for the largest cities was $91.75.

Oral hygienists in the United States received an average wage of $105 a month during 1939. This was increased to $111 a month in 1940 and to $119 in 1941. In terms of percentages, this amounted to an average increase of 5.7 per cent in 1940 and 10.8 per cent in 1941. While comparison of average wages paid in various sections of the country and in communities of varying sizes can be made from Tables 1 and 2, such a comparison is not advisable. The number of oral hygienists reported from each of the nine areas and in each of the nine sizes of community groups is too small to give a dependable representation. However, the national averages can be accepted with some degree of confidence. This statement applies equally to the average wages of dental technicians and assistant licensed dentists.

TABLE 5.—DISTRIBUTION OF WAGE RATES OF DENTAL EMPLOYES BY TYPE IN THE UNITED STATES (1939)

Monthly Wage Rate	All Types of Employes	Dental Assistants	Oral Hygienists	Dental Technicians	Assistant Licensed Dentist
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Total	0.1	0.2	2.5	3.1	4.8
$15— 19	0.3	0.2	.....	.....	.....
20— 24	2.2	2.5	.....	.....	.....
25— 29	1.6	1.9	.....	.....	.....
30— 34	3.2	3.5	.....	.....	.....
35— 39	2.6	3.2	.....	.....	.....
40— 44	11.5	11.4	2.5	15.6	.....
45— 49	6.2	7.5	.....	.....	.....
50— 54	8.8	9.8	2.5	3.1	4.8
55— 59	2.4	2.8	.....	.....	.....
60— 64	12.4	13.0	5.0	6.2	4.8
65— 69	5.4	6.6	.....	.....	.....
70— 74	5.0	5.5	10.0	3.1	.....
75— 79	4.4	4.8	2.5	3.1	.....
80— 84	9.8	11.0	10.0	3.1	14.3
85— 89	3.3	3.4	7.5	.....	4.8
90— 94	2.1	1.8	5.0	.....	.....
95— 99	0.8	0.9	2.5	.....	.....
100—149	14.0	9.6	47.5	46.9	.....
150—199	1.6	0.5	5.0	9.4	14.3
200—299	1.3	0.2	.....	6.2	28.6
300 and over	1.1	.....	.....	3.1	28.6

The average wage paid to the dental technicians employed in dental offices was $120 a month in 1939, $129 in 1940 and $141 in 1941. This represents increases of 7.5 per cent and 18.3 per cent in the years 1940 and 1941, respectively.

The average increase for all employes amounted to 8.5 per cent in 1940 and 16.9 per cent in 1941 as compared with the 1939 wage rates. The average wage increase during 1941 was almost identical for the West North Central, Middle Atlantic, South Atlantic and New England states, amounting to approximately 15 per cent of the 1939 wage rate for all of these areas. (Fig. 4.) Wage increases were larger for the remaining areas, reaching a maximum of a 21.2 per cent increase over the 1939 wage rates for the east south central states.

PERCENTAGE OF SALARIES INCREASED; MAGNITUDE OF INCREASE

It is obvious, of course, that the wage increases were not spread evenly among all employes, as might mistakenly be assumed in considering the average increase of wage rates. During the year 1940, approximately 47 per cent of all employes in dental offices received increases in their pay. (Table 3; Fig. 7.) For this group, the average increase amounted to about 18 per cent of the 1939 wage. By the end of 1941, about 63 per cent of all employes had received pay increases amounting to almost 27 per cent of their 1939 wage. (Fig. 8.) The New England and west north central states lagged behind the other sections of the country in granting pay increases, since, by the end of 1941, slightly less than 51 per cent of the employes in those areas had received a raise in pay during the period under study. However, both the New England states and the west north central states ranked high in a comparison of geographic areas with respect to the amount of the increases granted. In the east north central states, approximately

75 per cent of all employes had received pay increases by the end of 1941. These increases averaged approximately 27 per cent of the 1939 wage rates. Figures 5 and 6 show clearly the comparative percentage of employes who received pay increases, who received no pay increase and who received pay decreases during 1940 and 1941.

It is interesting to note that while there is observed a close correlation between size of the community and the wage rates, apparently there is no relationship between the size of the community and the percentage of employes receiving pay increases during the period 1939-1941. (Table 4; Fig. 9.) Apparently, the response in increasing wages to meet rising costs of living was just as prompt in the smaller communities. Also, there is to be found no marked correlation between the size of the community and the amount of the increases granted employes. (Figs. 10 and 11.) There appears to be a slight tendency for the pay increases to be proportionately larger in the smaller communities. However, the tendency is not clearly defined.

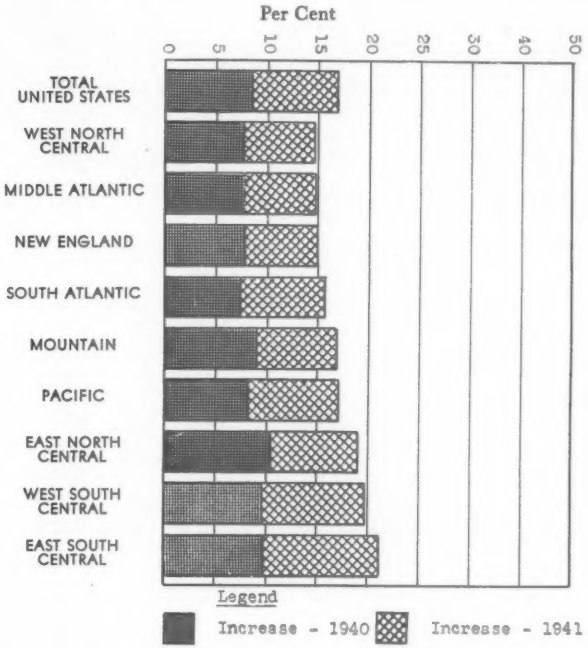


Fig. 4.—Percentage increase in wage rates for employes in dental offices during the periods 1939-1940 and 1939-1941. (Geographic areas are arranged in sequence according to percentage increase during 1941 over the 1939 wage rate).

RANGE OF WAGE RATES

Up to this point, mention has been made only of average wage rates. While the average rates are particularly significant in a comparison of wage levels from year to year or between various sections of the country, the average wage rate alone does not tell the whole story. It is of interest to know also what is the range of wage rates and to know how the employes are distributed through this range. The percentage of workers of various types falling in each wage group beginning with $10 a month and increasing by $5 intervals up to $100 a month and by larger intervals up to $300 a month are shown in Table 5. Similar information is given in more detail for dental assistants in Tables

6 and 7. These tables show the distribution of wage rates for dental assistants for the nine geographic areas and for the nine "size of community" groups.

In order to summarize the information regarding the distribution of wage rates contained in Tables 5-7, a quartile distribution of wage rates has been computed. That is to say, the range of wage rates was computed for the 25 per cent of employes having the lowest wages. The range of rates was then computed for the second, third and fourth quarter (highest wage group) of the employes. It was found that among dental assistants 25 per cent received less than $45 a month during the year 1939; 25 per cent received between $45 and $63 a month; 25 per cent received between $63 and $81 a month, and 25 per cent received more than $81 a month. With increases in salary, the wage range stepped up until, in 1941, the upper limit for the lowest income group was $59 a month, the second group received between $59 and $73 a month, the third group between $73 and $89 and the fourth group more than $89.

TABLE 6.—DISTRIBUTION OF WAGE RATES OF DENTAL ASSISTANTS ACCORDING TO GEOGRAPHIC AREA (1939)

Monthly Wage Rate	Total United States	Geographic Area: New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West North Central	Mountain	Pacific
Total	Per Cent 0.2	Per Cent 3.0	Per Cent 0.7	Per Cent 0.7	Per Cent 1.5	Per Cent 2.0	Per Cent 7.1	Per Cent 2.6	Per Cent 7.1	Per Cent 1.6
$15— 19	0.2	—	—	—	—	—	—	—	—	—
20— 24	2.5	—	—	2.9	7.7	4.1	7.1	2.6	7.1	—
25— 29	1.9	3.0	0.7	2.2	1.5	4.1	—	2.6	7.1	1.6
30— 34	3.5	3.0	4.1	2.9	9.2	2.0	7.1	—	—	1.6
35— 39	3.2	3.0	1.4	4.3	4.6	6.1	7.1	—	7.1	1.6
40— 44	11.4	18.2	8.2	8.7	12.3	14.3	42.9	17.9	21.4	4.7
45— 49	7.5	6.1	8.2	8.7	4.6	8.2	7.1	7.7	21.4	3.1
50— 54	9.8	9.1	9.5	8.0	16.9	8.2	—	15.4	14.3	6.2
55— 59	2.8	3.0	2.0	2.2	4.6	—	7.1	7.7	—	3.1
60— 64	13.0	3.0	19.7	16.7	13.8	8.2	—	7.7	—	6.2
65— 69	6.6	—	6.1	8.7	6.1	4.1	7.1	10.3	—	7.8
70— 74	5.5	3.0	1.4	10.1	1.5	6.1	—	5.1	7.1	10.9
75— 79	4.8	9.1	4.1	3.6	3.1	4.1	7.1	2.6	—	10.9
80— 84	11.0	21.2	12.9	10.1	4.6	10.2	—	12.8	7.1	12.5
85— 89	3.4	9.1	4.1	1.4	1.5	2.0	7.1	—	7.1	6.2
90— 94	1.8	—	2.7	2.9	3.1	—	—	—	—	—
95— 99	0.9	—	2.0	0.7	—	—	—	—	—	1.6
100—149	9.6	9.1	10.2	5.8	4.6	18.4	—	7.7	—	20.3
150—199	0.5	—	2.0	—	—	—	—	—	—	—
200—299	0.2	—	0.7	—	—	—	—	—	—	—
300 and over	—	—	—	—	—	—	—	—	—	—

The range of wages as shown above for dental assistants is also given for oral hygienists, dental technicians and assistant licensed dentists. This information can be readily obtained from Table 8.

LABORATORY SERVICE AND SUPPLIES

With the assistance of the Dental Labora-

tories Institute of America, a survey was made among a representative group of dental laboratories to determine the effect of increasing costs on the prices of the various services that they render the dentist. Since the laboratories offer a wide range of service, and since there has been no uniformity in the price adjustment for the various types of services, it is difficult to arrive at an average figure to represent the general price increase. To determine the proper weights to assign to each item that the dentist obtains from the laboratories would involve a more detailed study than could be made at this time. However, from all of the reports received, it has been estimated that the overall increase since 1939 in the cost of laboratory services amounts to about 15 per cent. Representatives of the dental laboratories explain that during the period 1939-1941, substantial wage increases have been granted to their employes. Since the expense of operating a dental laboratory is largely labor costs, it has been found necessary to increase prices to meet increased costs. It seems probable that the wage scale of technicians employed in dental offices would follow in general the wage scales prevailing in the dental laboratories. It was shown earlier in this report that the dental technician employed in the dental office had received wage increases during 1939-1941 amounting to about 18 per cent. This increase in wage rates follows closely the estimated increase of 15 per cent in the cost of laboratory service.

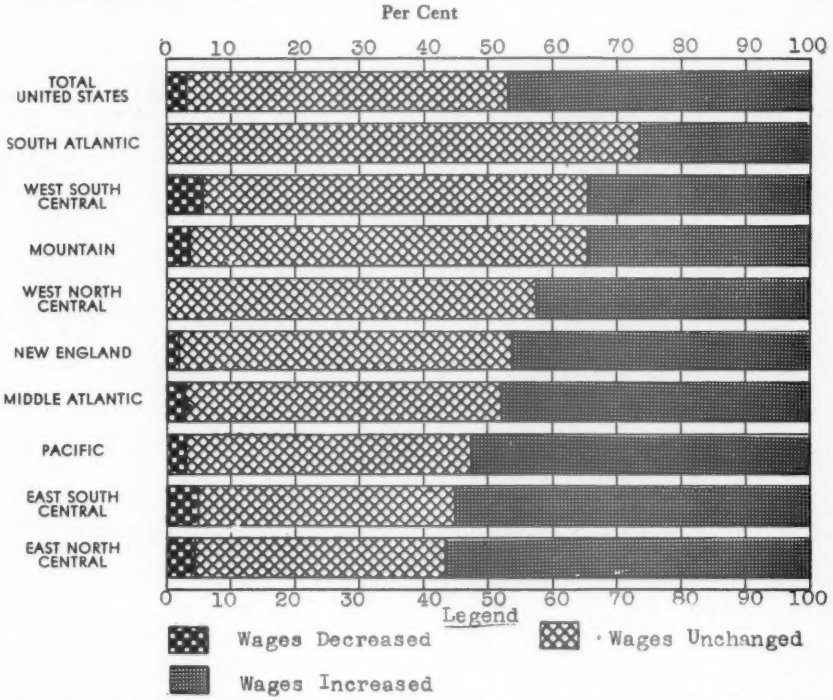


Fig. 5.—Percentage of salary rates of employes in dental offices reported as having been increased, decreased, or unchanged between the years 1939 and 1940; according to geographic area. (Geographic areas arranged in sequence according to percentage receiving wage increase during 1940).

Because of the wide variety of items and the many brands of materials that come under the head of dental supplies, it is even more difficult to strike an average in considering price increases than was the case

with laboratory service. However, an attempt has been made to select a representative group of items and to determine to what extent their prices have been affected. A list of these items, classified roughly according to type, is given in Table 9. Price comparison of average golds for four years is given in Table 10.

The tooth prices (Table 11) were the same in 1939 and 1940. They were changed July 15, 1941. Equipment prices have advanced about 7.5 per cent on the average.

While it is extremely difficult to determine with any accuracy the relative amounts used by the dentist in the long list of items, it would doubtless be agreed that alloy, anesthetics, burs, cements, instruments, denture materials and dental gold make up the bulk of the dentist's purchases. These items have been marked with an asterisk in Table 9. It will be noted that there has been no increase in the price of most of these more common items. The price of golds increased but slightly during this period, perhaps 3 or 4 per cent. The prices on teeth have also remained fairly constant with, perhaps, a 2 or 3 per cent increase. The items of more infrequent purchase such as forceps, handpieces and brushes, have increased more substantially. The price on office equipment has also increased by a significant amount. However, since it is the purpose of this study to determine the increase in cost of maintaining an established practice, the price of permanent equipment is not to be considered.

A rough estimate of a 3 per cent increase in the total cost of dental supplies would probably be close to the truth; and 5 per

TABLE 7.—DISTRIBUTION OF WAGE RATES OF DENTAL ASSISTANTS ACCORDING TO SIZE OF COMMUNITY (1939)

Monthly Wage Rate	Total United States	Size of Community								
		Under 1,000	1,000 — 2,499	2,500 — 4,999	5,000 — 9,999	10,000 — 24,999	25,000 — 49,999	50,000 — 99,999	100,000 — 499,999	500,000 and Over
Total	Per Cent 0.2	Per Cent 11.1	Per Cent 3.4	Per Cent 3.3	Per Cent 3.0	Per Cent 1.3	Per Cent 1.7	Per Cent 1.5	Per Cent 1.0	Per Cent 0.6
$15— 19	0.2	—	—	—	—	1.3	—	—	—	—
20— 24	2.5	—	13.8	10.0	—	1.3	3.5	—	3.0	0.6
25— 29	1.9	—	10.3	3.3	3.0	2.6	1.7	3.1	1.0	—
30— 34	3.5	33.3	10.3	—	6.1	3.9	3.5	1.5	4.0	1.2
35— 39	3.2	—	13.8	6.7	—	5.2	5.3	3.1	1.0	1.2
40— 44	11.4	33.3	20.7	10.0	24.2	10.4	10.5	10.8	11.0	7.4
45— 49	7.5	—	6.9	13.3	12.1	6.5	8.7	—	9.0	8.0
50— 54	9.8	11.1	13.8	16.7	15.1	10.4	7.0	12.3	9.0	6.7
55— 59	2.8	—	—	3.3	—	5.2	5.3	4.6	2.0	1.8
60— 64	13.0	—	3.4	10.0	24.2	10.4	7.0	21.5	13.0	13.5
65— 69	6.6	—	—	10.0	6.1	11.7	7.0	7.7	8.0	3.7
70— 74	5.5	—	—	3.3	3.0	10.4	12.3	4.6	3.0	4.9
75— 79	4.8	11.1	3.4	3.3	—	3.9	7.0	3.1	3.0	7.4
80— 84	11.0	11.1	3.4	6.7	6.1	9.1	5.3	7.7	9.0	19.6
85— 89	3.4	—	—	—	—	2.6	3.5	4.6	6.0	3.7
90— 94	1.8	—	—	—	—	1.3	—	1.5	3.0	3.1
95— 99	0.9	—	—	—	—	—	3.5	—	2.0	0.6
100—149	9.6	—	—	3.3	—	3.9	8.8	13.8	13.0	14.1
150—199	0.5	—	—	—	—	—	—	—	—	1.8
200—299	0.2	—	—	—	—	—	—	—	—	0.6

TABLE 8.—DISTRIBUTION* OF WAGE RATES OF EMPLOYES IN DENTAL OFFICES, BY TYPE, FOR 1939, 1940 and 1941

Occupation Range of Wage Rates	1939	1940	1941
Dental Assistant			
25%: Salary under	$45	$52	$59
50%: Salary under	63	66	73
75%: Salary under	81	83	89
Oral Hygienist			
25%: Salary under	$81	$83	$96
50%: Salary under	103	108	117
75%: Salary under	129	136	143
Dental Technician			
25%: Salary under	$65	$75	$80
50%: Salary under	117	118	133
75%: Salary under	143	146	175
Assistant Licensed Dentist			
25%: Salary under	$86	$112	$94
50%: Salary under	225	244	242
75%: Salary under	306	306	310

*Quartile distribution.

TABLE 9.—APPROXIMATE ADVANCE IN PRICE OF SUNDRY DENTAL SUPPLIES FROM 1939 TO THE PRESENT TIME

Item	Approximate Advance Per Cent
Abrasive points	10
Absorbents	10
*Alloy	0
*Anesthetics	0
Base plates (pkg. of 1 doz.)	0
Base plates (per 1,000)	25
Broaches	0
Brush wheels (lab.)	40
T. P. brushes	25
*Burs—discontinued quantity rates above 1 gross, dozen and 1 gross	0
*Cements	0
*Impression compounds	0
Investments	0
Colloids	Not available
Paper disks	5
Forceps	15
Handpieces	10
*Instruments	0
Mirrors	10
Vulcanized rubber	10
Waxes	33⅓
Plastic denture materials	0†

*These items constitute the bulk of a dentist's purchases.

†Reduced 30 per cent.

cent would certainly cover the increase in the average cost of such supplies. The question may arise as to why there should be such a wide disparity in the increase in laboratory costs and the increase in the cost of supplies. The answer is found in the relative amount of the cost of production assignable to labor costs. As has been pointed out, the costs of operating a dental laboratory are for the most part labor costs, whereas labor costs are relatively small in the expense of producing dental supplies. The supply dealers also point out that the nature of many of their products is such that they are carrying a large inventory of stock that dates back to 1939. This stock was produced before prices began spiraling upward.

TABLE 10.—PRICE COMPARISON OF AVERAGE GOLDS 1939, 1940, 1941 AND 1942

	1939 Dwt.	1940 Dwt.	1941, 1942 Dwt.
Inlay gold	$1.88	$1.88	$1.95
Partial gold	1.95	1.95	2.00
Clasp wire	2.21	2.21	2.32
22K plate	1.93	1.95	2.00
615 solder	1.35	1.36	1.41
	$9.32	$9.35	$9.68
Average:	$1.86 and 3/5 dwt.	$1.87 dwt.	$1.93 and 3/5 dwt.

TABLE 11.—TOOTH PRICES

	1939 and 1940	1941 and 1942
1 x 6 New Hue Vulcanite	$2.40	$2.40
1 x 6 Trubyte Vulcanite	1.80	1.80
1 x 6 Solila	1.02	1.14
1 x 6 New Solila	1.20	1.32
1 x 8 New Hue Diatoric	0.60	0.72
1 x 8 Trubyte Diatoric	0.60	0.68
1 x 8 Dentsply Diatoric	0.40	0.48
1 x 14 Famous	0.75	0.90

TOTAL INCREASE IN COST OF OPERATING A DENTAL OFFICE

It was pointed out in the first article that, for the nation as a whole, the rental rates on dental offices had increased by approximately 4 per cent during the period 1939-

1940. In the present article, it has been shown that wage rates have increased by approximately 16.9 per cent, laboratory costs by an estimated 15 per cent and dental supplies by about 5 per cent. In order to determine the average increase in the total cost of conducting a dental practice, it is necessary to weight the increases in the individual items of cost according to the proportion of the total cost that each item constitutes. In a study by Leven and Beck,[1] it was found that office rent accounts for 19.2 per cent of the total cost of conducting a practice; salaries of assistants in the dental office, for 25.6 per cent; laboratory service, for 18.9 per cent; supplies, for 17.7 per cent, and miscellaneous, for 18.7 per cent. Weighting the increases in the costs of individual items according to the distribution of the total cost yields an average increase in the total cost of approximately 8.8 per cent. This does not take into account any increase in the item indicated as "miscellaneous" costs, since no figures were available. Should the increases in miscellaneous costs amount to as much as 6 per cent, the increase in the total cost would be equal to approximately 10 per cent. It is entirely reasonable to assume that there has been an increase of at least this amount in the miscellaneous item. Consequently, it is assumed that the average increase in the cost of conducting a dental

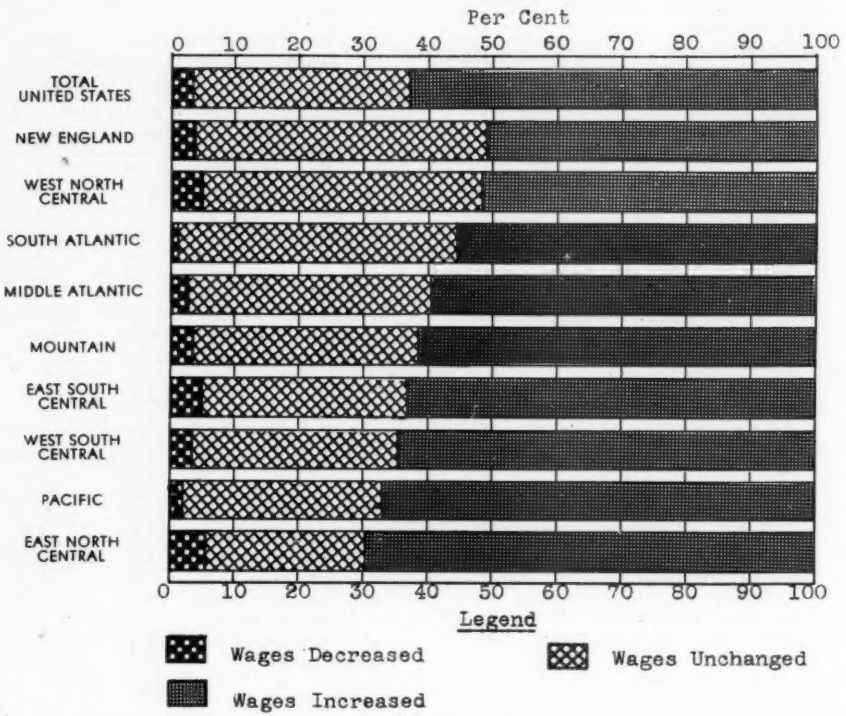


Fig. 6.—Percentage of salary rates of employes in dental offices reported as having been increased, decreased or unchanged between the years 1939 and 1941; according to geographic area. (Geographic areas arranged in sequence according to percentage receiving wage increases during 1941.)

1. LEVEN, MAURICE, and BECK, DOROTHY F.: Practice of Dentistry and Incomes of Dentists in Twenty States: 1929. Chicago: University of Chicago Press, 1932.

practice during the period 1939-1941 is equal to about 10 per cent. Attention is called to the fact that this figure of 10 per cent is an average and that the costs in many dental offices will have risen by more than that amount, while in others the increase will be less than that amount. For example, the rent increases during 1939-1941 were reported by only 26 per cent of the dentists, and the average increase for this group amounted to more than 19 per cent. While individuals have been affected to a greater or less degree, the problem must be thought of and dealt with in terms of the experience of the average dentist.

In order to maintain the same net income during 1942 as was received during 1939, it will be necessary for the average dentist to increase his gross income by approximately 4 or 5 per cent. This conclusion is based on an estimate of the costs of practice as equal to approximately 40 per cent of gross income. This estimate takes into consideration only the increase in the costs of practice and represents the increase in gross income necessary to maintain the same income in terms of dollars. It does not make any allowance for the depreciated value of the dollar in terms of the increased cost of living.

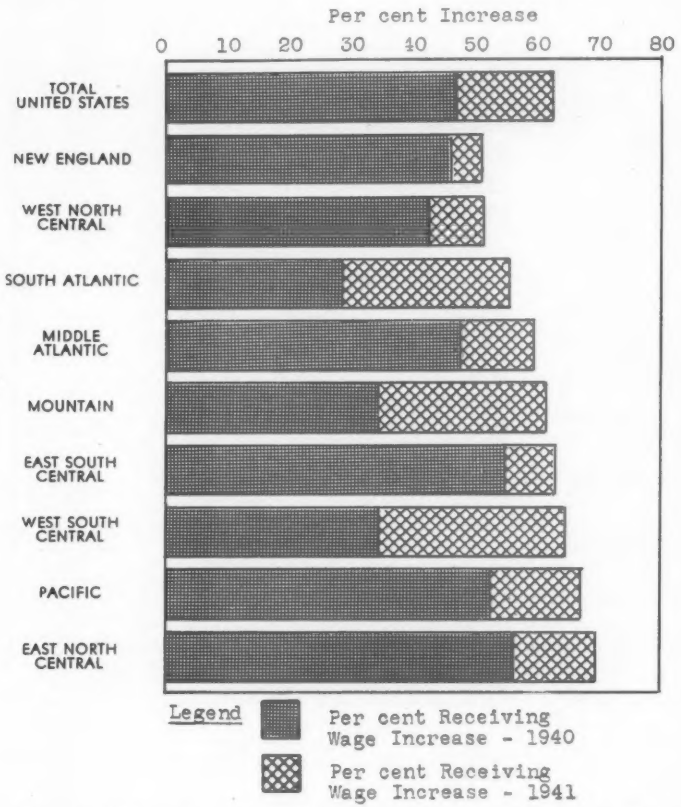


Fig. 7.—Percentage of employes in dental offices receiving wage increases during the periods 1939-1940 and 1939-1941 according to geographic area.

While it is the purpose of this study to

determine only the increase in the cost of conducting a dental practice, it may be pointed out that the Federal Bureau of Labor Statistics reports that the cost of living has increased by approximately 30 per cent over the period 1939-1941. Consequently, if net income is to be adjusted in 1942 to have a purchasing value equal to the 1939 level, the gross income must be increased by approximately 18 per cent to take care of this he is to maintain a net income equivalent in purchasing power to his 1939 income.

It does not necessarily follow that this increase must be acquired through an increase in the dentist's fee schedule. The increase in gross income may be achieved through an increase in the number of patients cared for. With the increase in general prosperity, the dentist has probably experienced a marked increase in his practice. Furthermore, having

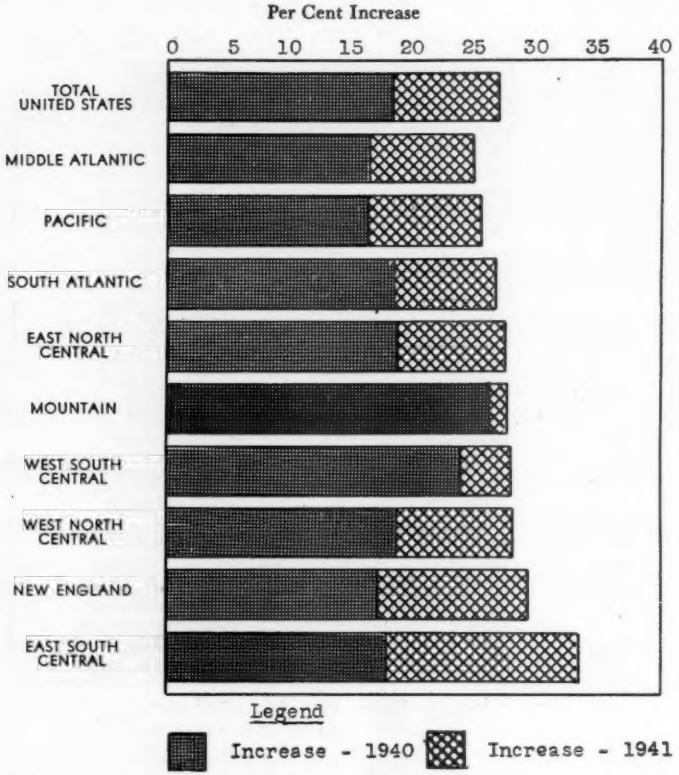


Fig. 8.—Percentage increase during 1940 and 1941 over the 1939 wage rates of employes in dental offices who received a raise in pay during this period; for geographic areas. (Geographic areas arranged in sequence according to percentage increase in 1941.)

increase and by about 4 per cent to cover the increase in the costs of conducting a dental practice. Thus, the gross income of the average dentist in 1942 must be approximately 22 per cent greater than in 1939 if less competition from the finance company collecting on the automobile and refrigerator, the dentist should receive an unusually high percentage of collections on his dental bills.

Obviously, it is impossible to advise the in-

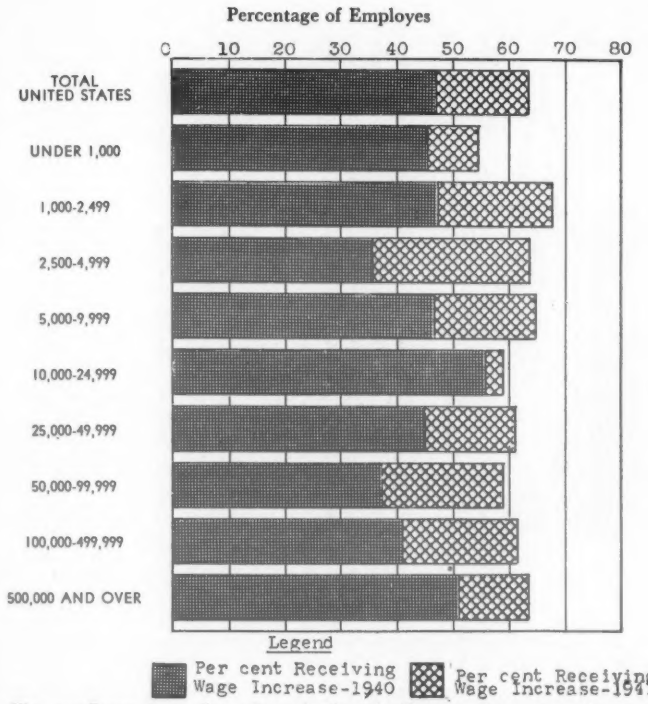


Fig. 9.—Percentage of employes in dental offices receiving wage increases during periods 1939-1940 and 1939-1941 according to size of community.

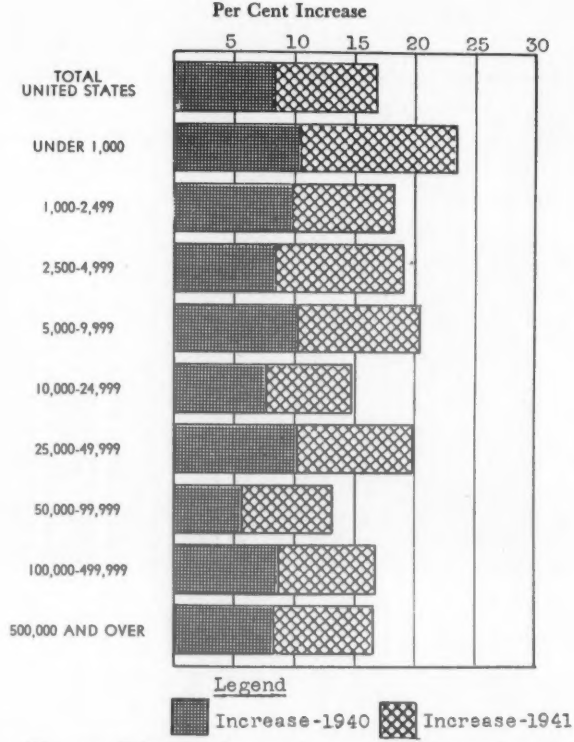


Fig. 10.—Percentage increase in wage rates for employes in dental offices during periods 1939-1940 and 1939-1941.

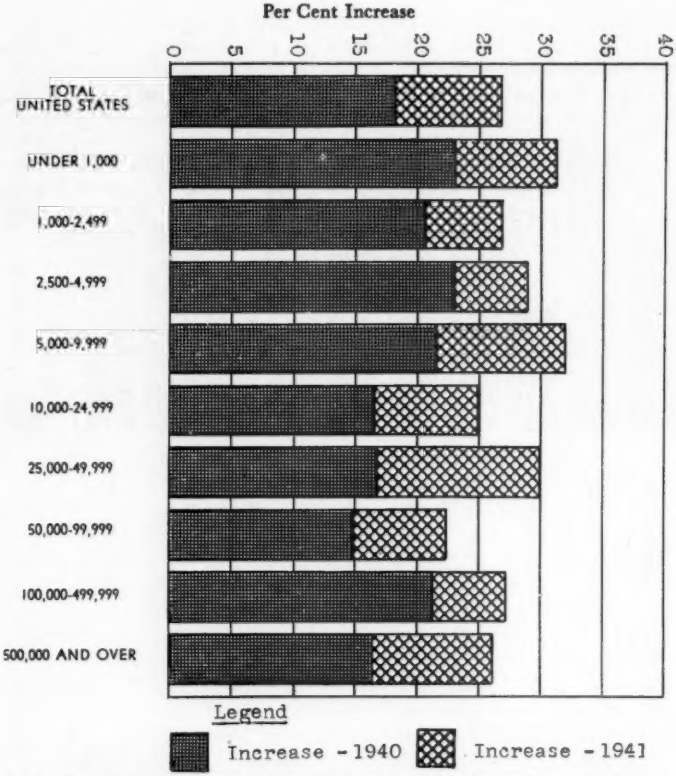
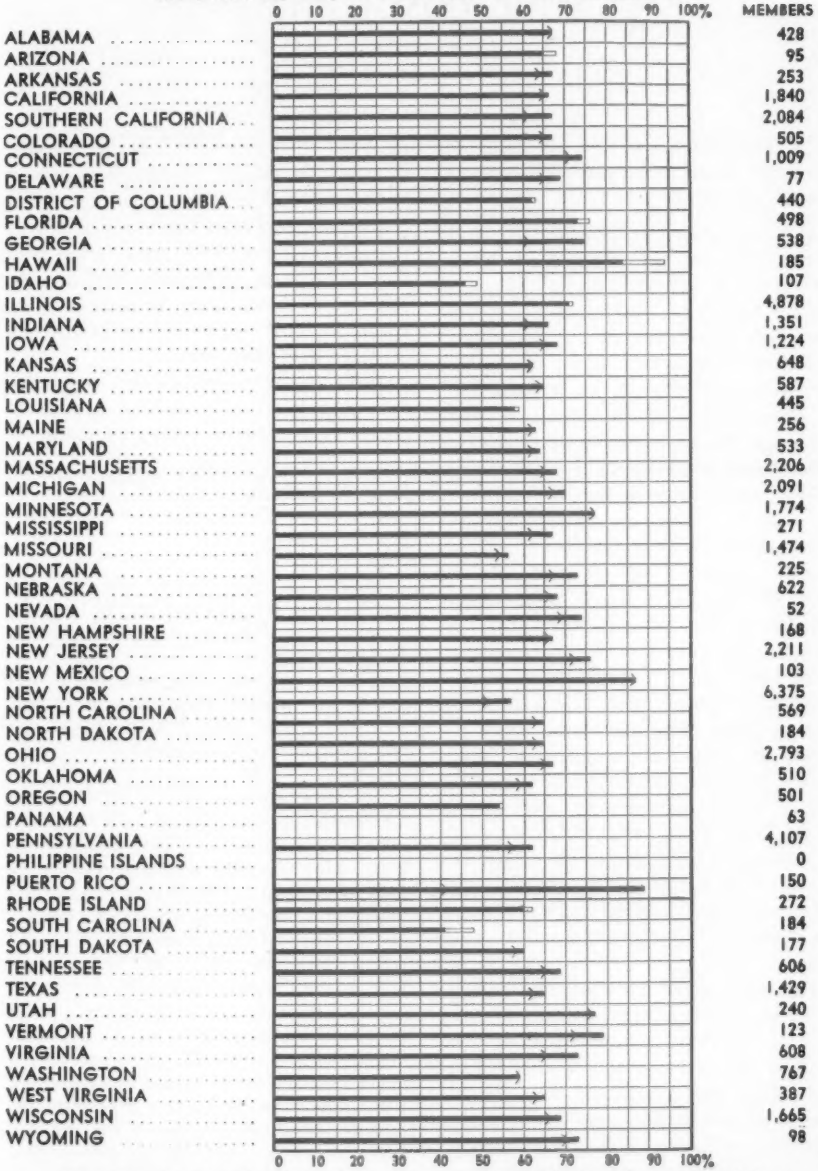


Fig. 11.—Percentage increase during 1940 and 1941 over the 1939 wage rates of employes in dental offices who received raise in pay during this period.

dividual dentist as to what adjustments he should make in his practice on the basis of a study like this. However, it is hoped that the individual dentist or local dental society will size up their own situation in the light of this analysis and thus be able to determine what adjustments in their practice, if any, need be made in order to keep in line with the present price structure.

Membership Page

PERCENTAGE OF DUES RECEIVED IN CENTRAL OFFICE AS OF SEPTEMBER 30, 1942, AS COMPARED TO 1941 MEMBERSHIP



Percentage based on dental population figures supplied by the State Society Secretaries.

1942 percentage. 1941 percentage.

ANNUAL REPORT OF THE SECRETARY OF THE RELIEF COMMISSION AND DENTAL RELIEF FUND COMMITTEE

JULY 1, 1941 TO JUNE 30, 1942

To the Chairmen and Members of the Relief Commission and Dental Relief Fund Committee:

It is a pleasure to submit the following report. The figures are evidence of an ever-growing interest among the membership at large. The receipts this year from seals approached double the amount collected eight years ago. Sixty-eight members or their widows were helped, as compared with twenty-three eight years ago, this representing an increase of over $9,000 in payments from this fund.

Since the ravages of war are beginning to reach our ranks, we have received a communication from California regarding the family of one of our members from Manila. The family secured safe passage to the United States, but the member, for some reason, was unable to accompany his family. For several months, he has not been heard from and his fate seems very uncertain. Since the family is large and unprepared financially, upon the suggestion of the California Relief Committee, applications were sent to the wife that she might apply for assistance until she could adjust her affairs. The California Committee was asked to keep this office informed as to her needs. No application has been presented to date.

This case would be somewhat irregular in normal times, but no doubt in these days of uncertainty and suffering, the A. D. A. Relief Fund will be called upon and will be able to alleviate the pain and anxiety of more than one of our members and families.

Every member of the American Dental Association should be proud of a part in this altruistic work, made possible through the Relief Fund. We wish it were practical for every member of our organization to read the many letters of thanks and appreciation from fellow dentists, who from ill health, bad luck or misfortune have been helped back to health or have had their lives brightened because "somebody cares."

With the permission of the writer, the following letter is submitted as an example of gratitude and appreciation:

Friday, May 15, 1942

Dr. E. E. Graham,
58 East Washington Street,
Chicago, Illinois.

Dear Doctor:

Tuesday of this week I received your checks. I am very grateful for this help and appreciate very much the promptness in sending it to me.

So far as I know I did not miss a year buying my stamps; even this past Xmas, little did I ever think I would be in this condition and would be receiving relief from this fund.

The boys here (and by the boys, I mean the dentists in our county society) have been more than kind to me. The papers to be filled in for this relief were obtained for me last October 1941. I put it off as long as I could, for I was able to work a few hours a day, but since March I have done nothing.

This past Christmas, just about noon, three of the dentists came to my home with a small box. When I opened it, there was a beautiful Christmas card with the names of all of the boys in our County Society, the names of three local dentists not belonging to the association, and a new $100 bill. Dr. Graham, this to me was one of the grandest things I have ever heard of. To tell you how much I appreciated that gift is impossible.

I have been going to the hospital every

CHRISTMAS SEAL RECEIPTS

States	1940-1941	1941-1942	Increase	Decrease	Per Capita 1941-1942	Per Capita 1941-1942
1. Alabama	$494.68	$543.39	$48.71		$1.15	$1.35
2. Arizona	91.50	85.00		$6.50	0.91	0.86
3. Arkansas	49.10	67.60	18.50		0.22	0.28
4. Army	470.75	1,114.00	643.25		1.68	2.62
5. California	770.50	912.00	141.50		0.43	0.50
6. Southern California	890.50	1,127.00	236.50		0.49	0.58
7. Colorado	181.16	176.00		5.16	0.37	0.36
8. Connecticut	519.00	811.00	292.00		0.56	0.84
9. Delaware	38.00	46.00	8.00		0.56	0.63
10. District of Columbia	693.00	713.00	20.00		1.52	1.57
11. Florida	368.00	321.00		47.00	0.71	0.61
12. Foreign	5.00			5.00	0.36	
13. Georgia	152.50	195.25	42.75		0.35	0.45
14. Hawaii		86.50	86.50			0.46
15. Idaho	41.00	44.50	3.50		0.32	0.39
16. Illinois	2,317.30	2,607.10	289.80		0.50	0.55
17. Indiana	499.50	631.00	131.50		0.41	0.50
18. Iowa	593.60	642.75	49.15		0.50	0.54
19. Kansas	257.16	278.65	21.49		0.40	0.43
20. Kentucky	334.16	322.50		11.66	0.62	0.56
21. Louisiana	139.70	161.00	21.30		0.32	0.35
22. Maine	88.00	105.00	17.00		0.38	0.42
23. Maryland	264.50	302.00	37.50		0.51	0.58
24. Massachusetts	720.50	766.02	45.52		0.33	0.35
25. Michigan	646.40	776.00	129.60		0.38	0.39
26. Minnesota	682.40	770.60	88.20		0.37	0.43
27. Mississippi	110.00	124.50	14.50		0.43	0.49
28. Missouri	1,343.75	1,527.25	183.50		0.92	1.07
29. Montana	134.52	133.10		1.42	0.64	0.62
30. Navy	88.00	71.00		17.00	0.39	0.30
31. Nebraska	251.70	303.28	51.58		0.43	0.51
32. Nevada	20.00	11.50		8.50	0.47	0.24
33. New Hampshire	86.00	108.00	22.00		0.54	0.65
34. New Jersey	941.60	973.70	32.10		0.46	0.46
35. New Mexico	48.00	64.00	16.00		0.49	0.62
36. New York	4,006.50	3,826.00		180.50	0.76	0.66
37. North Carolina	261.50	393.91	132.41		0.45	0.66
38. North Dakota	71.20	110.15	38.95		0.38	0.61
39. Ohio	1,104.50	1,261.60	157.10		0.40	0.47
40. Oklahoma	177.00	192.00	15.00		0.37	0.39
41. Oregon	227.05	274.55	47.50		0.47	0.52
42. Panama Canal Zone	15.00	15.00			0.88	0.68
43. Pennsylvania	1,601.00	1,732.90	131.90		0.44	0.45
44. Philippine Islands	5.00			5.00	5.00	
45. Public Health Service	57.50	61.50	4.00		0.44	0.45
46. Puerto Rico	4.00	24.00	20.00		0.06	0.31
47. Rhode Island	101.00	112.50	11.50		0.36	0.40
48. South Carolina	61.00	68.00	7.00		0.32	0.31
49. South Dakota	53.15	57.15	4.00		0.29	0.33
50. Tennessee	489.50	565.50	76.00		0.92	1.00
51. Texas	518.12	555.00	36.88		0.41	0.40
52. Utah	241.50	278.50	37.00		0.97	1.14
53. Vermont	34.00	28.00		6.00	0.31	0.25
54. Vet. Administration	95.00	85.00		10.00	0.79	0.77
55. Virginia	277.15	302.50	25.35		0.49	0.55
56. Washington	366.86	412.93	46.07		0.47	0.52

56. Washington.....	366.86	412.93	46.07		0.47	0.52
57. West Virginia.....	192.00	215.00	23.00		0.49	0.55
58. Wisconsin.....	536.75	581.60	44.85		0.47	0.37
59. Wyoming.....	56.00	45.00		11.00	0.67	0.47
60. Commercial Houses..	413.95	408.00		5.95		
	$25,297.71	$28,527.48	$3,550.46	$320.69		
		25,297.71	320.69			
		$3,229.77	$3,229.77			

SUMMARY OF CHRISTMAS SEAL FUND OPERATION*

Year	Granted	Paid	No. Applicants	Sales Receipts
1934-1935	$4,655.96	$4,298.60	23	$15,574.97
1935-1936	9,469.52	5,856.96	43	18,389.32
1936-1937	10,118.70	8,125.63	50	20,739.87
1937-1938	10,841.00	9,949.10	57	23,873.54
1938-1939	14,828.96	12,345.16	72	23,152.65
1939-1940	13,960.00	13,694.80	72	23,966.84
1940-1941	12,531.40	11,955.20	63	25,297.71
1941-1942	15,198.40	13,439.10	68	28,527.48
Eight year increase:	$10,542.44	$9,140.50	45	$12,952.51

*Seventy-two grants to sixty-eight applicants; twenty-nine states, eighty-two recipients; assistance rendered three widows.

thirty days for treatment. One evening, before the day of going to the hospital for this treatment, one of the boys came to see me and put a fifty dollar bill in my pocket. There is not a week passes that some of the dentists don't send us food, flowers, smokes or some remen.brance.

I am very proud of my profession and the kindness it has shown me. I was operated on for this tumor August 1940, was back for treatment in October 1940, and November 1940, was in the hospital the whole month for x-ray treatment. March 1941, my wife was operated on for a brain tumor, was in the hospital three months with special nurses and is still helpless and cannot be left alone, so it still means nurses night and day; and now I am down. We have no children, and the cost, with loss of time and health insurance canceled when I was on my feet in September 1940, is now over $11,000. That is why this relief has been asked for.

Again many thanks for your prompt attention to this matter, and wishing you all the good luck in the work, I am

Sincerely yours.

Another recipient of relief, blind and paralyzed, came into a small income of his own. He stopped his relief from the dental societies and made a contribution of $100 ($50 to the A. D. A. Relief Fund and $50 to his state fund) as an expression of appreciation for the assistance given to him and his wife during the time of their greatest need.

Many similar letters are received each year. Also, to show their deep appreciation, many, from their relief checks, return a small contribution to the Relief Fund that others may share the benefits in time of need.

The secretary wishes to express his sincere appreciation for the many kindnesses shown and cooperation given him during the year.

Respectfully submitted,

E. E. GRAHAM, *secretary*,
Relief Commission
Dental Relief Fund Committee

CURRENT LITERATURE

Hereditary Hypoplasia of Enamel

By J. Staz

An unusual case of hereditary enamel hypoplasia (agenesia of the enamel, aplasia or dwarfed enamel) occurred in a 14-year-old European girl. The cause of this condition is unknown. The main abnormality appears to be a lack of complete calcification of the enamel which is of epithelial origin and what may be termed overcalcification of the dentin and pulp, which arise in the mesoderm.—*S. Afr. D. J.*, 16:223, July 1942.

Peter P. Dale.

Highlights on Analgesia

By Saul L. Stanislaw

"What seems to be retarding the progress of analgesia in dentistry?"

Simply turning a handle on an apparatus to a set ratio of nitrous oxide and oxygen is the commonest cause of failure. One must learn the fundamental principles of analgesia. The loss of certain sensory faculties without loss of consciousness is caused by the fact that the nitrous-oxide displaces a certain amount of oxygen. Its many uses range from preparing cavities to treating hysteria after surgery. It is inadvisable to use it in epilepsy, bad heart conditions, debilitation and status lymphaticus. It is difficult to use it on alcoholics, drug addicts and persons with respiratory disturbances. The patients are sensitive to hot and cold air and water. Dentures should be removed. The operator should continuously check the apparatus for leakage and to determine the amount of the gases in tanks.

To avoid nausea, analgesia should not be too deep. Swallowing of blood and débris is prevented by the use of a metal saliva ejector. Wide fluctuation of gases is avoided.

Premedication masks many of the symptoms of analgesia. The operator must be able to recognize at least seventeen symptoms. A tight nasal inhaler is a great aid.

The dentist should know all the signs of anesthesia. The excitement stage calls for more oxygen and less nitrous oxide. The induction method of choice is as follows: With minimum pressure and starting with 100 per cent oxygen, the analgesic stage is approached cautiously. A suitable level of analgesia is maintained by judicious use of the air valve, and thus a minimum of nitrous oxide is used and the excitement stage is eliminated.

With this technic, analgesia is most satisfactory when from 10 to 15 per cent of nitrous oxide and from 85 to 90 per cent of oxygen, plus a small quantity of air, is used. —*D. Outlook*, 29:165, April 1942.

Acrylic Bridges with Gold Reinforcement

By I. E. Saby

This technic for acrylic bridge construction involves the preparation of a second shoulder on the incisal third of the retaining area previously prepared in the conventional manner for the reception of a jacket crown. A gold casting, made to cover the incisal third of this area, is connected with a gold bar to the other retainer, which is constructed in a similar fashion. Added retention and resistance can be obtained by processing the acrylic resin over this gold skeleton.—*D. Digest*, 48:418, September 1942.

R. Hildebrand.

Résumé of the Literature on Root Resorption

By S. R. Steadman

Resorption appears to be a manifestation of some disturbance of the tissues surrounding the tooth that may have a variety of factors. Three classes of root resorption occurring in permanent teeth are recognized: Group I, in which the causative factor is definitely known to be a follicle, cyst, granuloma or similar lesion; Group II, in which occasional resorption of devitalized teeth occurs; Group III, in which orthodontically treated and untreated vital teeth are resorbed. In untreated teeth, resorption occurs with no roentgenographic evidence of the causal factor. Occasionally, a rapid type occurs, some-

times associated with a systemic disturbance. If this systemic disturbance improves, root resorption ceases. Excessive force, inadequate diet or a predisposing condition may contribute to root dissolution in orthodontically treated cases. Some patients appear to have root resorption regardless of the manner of treatment; others do not. Resorption probably need not occur in more than 20 per cent of all cases and may be further reduced by the exercise of care. Those teeth that have been resorbed during treatment remain firm, react vitally to all tests and do not become discolored or feel different subjectively.—*Angle Orthodonist,* 12:28, January 1942.

PETER P. DALE.

Electrosurgery in Dentistry

By W. I. OGUS

USE of the electric knife controls hemorrhage, minimizes infection and prevents regrowth of hypertrophied tissue. Healing generally is rapid and most postoperative complications are eliminated. Electrosurgical methods of exposing unerupted teeth, severing abnormal muscle and tissue attachments, excising hypertrophied tissues, eliminating periodontal pockets and sterilizing root canals have been found to be practical and satisfactory.—*D. Digest,* 48:411, September 1942.

R. HILDEBRAND.

Ammoniacal Silver Nitrate in the Treatment of Caries in Deciduous Teeth

By L. ENTELIS and I. TEENSTEIN

THE objectives of this investigation were fourfold: to determine (1) the depth of penetration of ammoniacal silver nitrate solution into carious areas, (2) whether the solution penetrated the normal dentin underlying the infected area, (3) whether use of this silver nitrate halted the progress of caries and (4) whether the method of application of silver nitrate solution was in any way related to the depth of penetration.

The experiments were carried out on deciduous teeth of children ranging from 8 to 11½ years. Only those teeth were chosen the roots of which were at least two-thirds resorbed and the permanent successors of which would soon assume their normal places in the arch. Vital teeth with previously untreated cavities extending into dentin were used. The cavities were excavated, hard, leathery decay being allowed to remain. The solution of ammoniacal silver nitrate was applied with cotton pellets. Eugenol was used to reduce nitrate to metallic silver.

Sections of the extracted teeth showed that the silver nitrate had penetrated to the base of the carious area, regardless of the depth of the cavity. There was a definite line of demarcation discernible between the apparently sound, uninfected dentin and the carious dentin. The latter was stained black by the dense silver deposit. No extension of the carious process was found beneath the deposition of silver in any one of the five cases that were permitted to remain in the mouth for varying lengths of time after treatment. No correlation was found between the method of application and either depth of penetration or amount of deposition.—*S. Afr. D. J.,* 16:281, August 1942.

GLEN FOOR.

Prophylactic Caries Control

By S. BREGSTEIN

A MODIFIED prophylactic odontotomy is suggested for conserving tooth structure. The author believes that pits and fissures need not be excavated, and that these areas can be rendered immune by the application of metaphen followed by a solution of ammoniacal silver nitrate reduced with oil of eugenol. Operations of this type are painless, and thus fear, especially in children, is eliminated. Since this treatment does not call for excavation and grinding, tooth structure is conserved.—*S. Afr. D. J.,* 16:275, August 1942.

GLEN FOOR.

Comparative Immunologic Studies with Salivary and Epithelial Extracts of the Dog, Cat and Rabbit

By W. SPAIN, R. GILLSON and M. STRAUSS

SAMPLES of saliva and epithelial extracts were obtained from the dog, cat and rabbit. The extracts were passed through a Seitz filter and standardized. Persons clinically sensitive to these animals were given 0.025 cc. intracutaneous injections of the two extracts. Those sensitive to one invariably reacted to the other. Neutralization of immune sera by salivary and epithelial extracts showed that the same protein unit strength of dog saliva is as effective as dog epithelium in neutralizing the skin sensitizing antibodies present in human allergic serum.

Comparative studies with salivary and epi-

thelial extracts on sensitized guinea-pigs showed marked variation in ability to produce contraction of the uterine horns. Injection of saliva extract into animals sensitized to epithelium showed contraction of the uterine horns in twenty-three of twenty-seven cases. Injections of epithelium into those sensitized to saliva caused uterine horn contraction in only eleven of thirty-three cases. This would seem to suggest the presence of some extra antigenic factor in saliva, as yet unaccounted for.—*J. Allergy,* 13:263, September 1942.

GLEN FOOR.

Primary Adamantinoma of the Ulna

By C. E. ANDERSON and J. B. SAUNDERS

IN a review of a case of primary adamantinoma involving the ulna, the case history, photomicrographs and a series of roentgenograms show the progress of the tumor over a period of five years. This is believed to be the first recorded case of adamantinoma arising in a long bone other than the tibia. In reviewing this case and the literature associated with it, the authors conclude that the tumor possesses a limited type of malignancy and that it extends itself by eroding the bone, but does not have the ability to metastasize or to invade adjacent tissues, and that chronicity and slow growth of the tumor are noteworthy. All patients give a definite history of limited trauma with tenderness, an increase in local temperature, edema and fluctuation in some instances.—*Surg. Gynec. & Obst.,* 75:351, September 1942.

FRANK W. ARCHIBALD.

Evaluating Dental Health Programs

By J. W. KNUTSON

IN order to demonstrate methods of evaluating dental health programs, statistical data concerning dental conditions of school children in two small urban communities were analyzed and compared. The conditions to which evaluation technics were applied are: (1) volume of administrative activity; (2) public response to a unit volume of administrative activity; (3) volume of clinical service dispensed, and (4) effect of a given program on dental health. Since the etiology of caries is unknown and preventive measures are still in the experimental stages, the exercise of procedures whereby the early detection and filling of carious teeth are accomplished becomes the primary purpose of a dental health program. Getting the child to the dentist and determining the volume and completeness of the service dispensed are therefore major objectives of such a program. The use of 100 per cent correction cards is a simple, inexpensive and effective means of motivating public interest and of collecting specific data as demonstrated by the apparent success of such a system in Waynesboro, Pa.—*Pub. Health Rep.,* 57:1287, August 28, 1942.

R. HILDEBRAND.

Large Salivary Calculus in Submaxillary Gland

By H. MEYERS

AFTER the insertion of full dentures in a patient 50 years of age, a previously undetected salivary concretion caused the tissue of the floor of the mouth to rupture in five places. Removal of the stone was accomplished without difficulty. The unusually large calculus weighed 1 ounce and was covered with a thick gelatinous substance that made it smooth and slippery.—*D. Digest,* 48:420, September 1942.

R. HILDEBRAND.

Ununited Fractures of the Symphysis

By H. L. HUBINGER

FRACTURE of the symphysis is one of the most difficult types to treat whether it is simple or complicated by other conditions. The large numbers of cases of delayed union and non-union are due mainly to local conditions such as degree of trauma, inadequate reduction, faulty immobilization, too early mobility and lack of treatment. The most obvious clinical sign of delayed union or non-union is movement, which may be accompanied by malocclusion, or collapse with constriction of the arch. Indicative of non-union is the finding of eburnation of the ends of the bone fragments in the x-ray film.

Treatment consists, in cases of delayed union, of rigid immobility over a long period of time. In cases of non-union, it may be necessary to dissect away the fibrous tissue from the ends of the bone fragments, "freshen" the ends and fit the fragments together, employing internal and external fixation.—*Mil. Surg.,* 91:320, September 1942.

A. PEARSON.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ACADEMY FOR PLASTICS RESEARCH IN DENTISTRY, Chicago, Ill., February 21, 1943.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (DENTAL SUBSECTION), New York, December 28.

AMERICAN ASSOCIATION OF ORTHODONTISTS, Chicago, May 3-6, 1943.

CHICAGO DENTAL SOCIETY, February 22-25, 1943.

DALLAS COUNTY (TEXAS) DENTAL SOCIETY MIDWINTER CLINIC, Dallas, January 25-27, 1943.

DENTAL PROTECTIVE ASSOCIATION, Chicago, Ill., December 21.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month, from October to June at the United States Public Health Service Auditorium, Washington.

GREATER NEW YORK DENTAL MEETING, New York, December 7-11.

NEW YORK SOCIETY OF ORTHODONTISTS, New York, November 9-10.

ODONTOLOGICAL SOCIETY OF WESTERN PENNSYLVANIA, Pittsburgh, November 3-5.

PACIFIC COAST SOCIETY OF ORTHODONTISTS, San Francisco, Calif., February 22-24, 1943.

PAN AMERICAN ODONTOLOGICAL ASSOCIATION, New York, December 9.

GREATER PHILADELPHIA ANNUAL MEETING, February 3-5, 1943.

STATE SOCIETIES

November

Florida, at Tampa (9-11)
Ohio, at Cincinnati (9-11)

February

Minnesota, at St. Paul (17-19)

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, February 15 and April 19, and at Los Angeles, March 22. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Connecticut, at Hartford, November 17-21. Clarence G. Brooks, New London, Recorder.

Indiana, at Indianapolis, December 14. D. Gordon Lamb, 819 Chamber of Commerce Bldg., Indianapolis, Secretary.

New Jersey, April 4. Walter A. Wilson, 150 E. State St., Trenton, Secretary.

North Carolina, at Raleigh, April 5, 1943. Wilbert Jackson, Rich Building, Clinton, Secretary.

Pennsylvania at Pittsburgh and Philadelphia, February 16-20, 1943. Reuben E. V. Miller, 61 N. Third St., Easton, Secretary.

Texas, at Dallas, December 7-10. Carl C. Hardin, 520 Littlefield Bldg., Austin, Secretary.

Virginia, at Richmond, March 30. John M. Hughes, 715 Medical Arts Bldg., Richmond, Secretary.

AMERICAN ACADEMY FOR PLASTICS RESEARCH IN DENTISTRY

THE meeting of the American Academy for Plastics Research in Dentistry will be held in the Palmer House, Chicago, February 21, 1943. Application for admission to the scientific session should be made to the secretary.

LAMAR W. HARRIS, *Secretary,*
25 E. Washington St.,
Chicago, Ill.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF ORAL DIAGNOSIS

OWING to the present emergency, the board of directors of the American Association of Oral Diagnosis has deemed it advisable to postpone the annual meeting, which was to

have been held in Boston, November 12-13.

H. JUSTIN ROSS, *Secretary,*
515 Madison Ave.,
New York, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE Dental Subsection of the American Association for the Advancement of Science will meet in New York December 28. The committee in charge of the meeting is composed of Arthur H. Merritt, William J. Gies and Paul C. Kitchin. There will be a symposium on "Dental Aspects of the Focal Infection Theory." Dentists and physicians are welcome.

PAUL C. KITCHIN, *Secretary,*
College of Dentistry,
Ohio State University,
Columbus.

AMERICAN ASSOCIATION OF ORTHODONTISTS

THE next meeting of the American Association of Orthodontists will be held at the Edgewater Beach Hotel, Chicago, May 3-6, 1943.

MAX E. ERNST, *Secretary,*
1250 Lowry Medical Arts Bldg.,
St. Paul, Minn.

CHICAGO DENTAL SOCIETY MIDWINTER MEETING

THE 1943 Midwinter Meeting of the Chicago Dental Society will be held at the Palmer House, February 22-25.

HAROLD W. OPPICE, *Secretary.*

DALLAS COUNTY DENTAL SOCIETY MIDWINTER CLINIC

THE sixteenth annual midwinter dental clinic sponsored by the Dallas County (Texas) Dental Society will be held at the Hotel Adolphus, Dallas, January 25-27, 1943. Three nationally known clinicians will be presented in a three-day study course. The fee of $15 includes the banquet and table clinics, January 26. Members of the American Dental Association are invited.

PHELPS J. MURPHEY, *Chairman,*
Publicity Committee,
Fairmount at Welborn,
Dallas.

DENTAL PROTECTIVE ASSOCIATION

THE annual meeting of the Dental Protective Association of the United States will be held at the Palmer House, Chicago, December 21 at 5 p.m. The report of the officers will be given. A board of directors will be elected, and such other business will be transacted as should come before the association. All members are urged to be present.

By order of the Board of Directors.

E. W. ELLIOTT, *Secretary.*

GREATER NEW YORK DENTAL MEETING

THE next Greater New York Dental Meeting will be held in the Hotel Pennsylvania, New York, December 7-11.

WALTER A. QUINN, *Chairman,*
Press and Publication.

NEW YORK SOCIETY OF ORTHODONTISTS

THE next meeting of the New York Society of Orthodontists will be held at the Waldorf-Astoria Hotel, New York, November 9-10.

NORMAN L. HILLYER, *Secretary,*
Professional Bldg.,
Hempstead.

ODONTOLOGICAL SOCIETY OF WESTERN PENNSYLVANIA

THE Odontological Society of Western Pennsylvania will hold its sixty-first annual fall meeting November 3-5 in the William Penn Hotel, Pittsburgh.

M. H. SMITH, *Office Secretary.*

PACIFIC COAST SOCIETY OF ORTHODONTISTS

THE next meeting of the Pacific Coast Society of Orthodontists will be held in San Francisco February 22-24, 1943.

EARL F. LUSSIER, *Secretary,*
450 Sutter Bldg.,
San Francisco.

PAN AMERICAN ODONTOLOGICAL ASSOCIATION

THE next annual dinner meeting of the Pan American Odontological Association will be held in the Hotel Pennsylvania, New York, December 9, at 6 o'clock.

RALPH HOWARD BRODSKY,
Executive Secretary,
14 E. 81st St.,
New York.

GREATER PHILADELPHIA ANNUAL MEETING

THE Greater Philadelphia Annual Meeting will be held February 3-5, 1943, at the Benjamin Franklin Hotel.

ABRAM COHEN, *Chairman,*
Publicity Committee,
269 S. 19th St.,
Philadelphia.

FLORIDA STATE DENTAL SOCIETY

THE next annual meeting of the Florida State Dental Society will be held at Tampa, November 9-11.

W. P. WOOD, JR., *Secretary,*
442 W. Lafayette St.,
Tampa.

MINNESOTA STATE DENTAL ASSOCIATION

THE sixtieth annual meeting of the Minnesota State Dental Association will be held in the Municipal Auditorium, Minneapolis, February 17-19, 1943.

L. M. CRUTTENDEN, *Secretary,*
498 Lowry Bldg.,
St. Paul.

OHIO STATE DENTAL SOCIETY

THE next annual meeting of the Ohio State Dental Society will be held at the Netherland-Plaza Hotel, Cincinnati, November 9-11.

EDWARD C. MILLS, *Secretary,*
255 E. Broad St.,
Columbus.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

THE next examinations to be conducted by the Board of Dental Examiners of California for a license to practice dentistry and for a license to practice dental hygiene in California will be held in San Francisco, commencing on February 15, 1943; in Los Angeles, commencing on March 22, 1943, and again in San Francisco commencing on April 19, 1943. All credentials must be in the office of the Secretary, Room 203, 515 Van Ness Avenue, San Francisco, at least twenty days prior to the date of the examinations. Address all communications to Kenneth I. Nesbitt, Secretary, Room 203, 515 Van Ness Avenue, San Francisco.

CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will meet in Hartford, November 17-21, for the examination of applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, apply to Clarence G. Brooks, Recorder, New London.

INDIANA STATE BOARD OF DENTAL EXAMINERS

THE next examination for licensure of the Indiana State Board of Dental Examiners will be held in Indianapolis beginning December 14 and continuing four days. All applications, fees and credentials must be in the hands of the secretary not later than ten days prior to the examination. For application, instructions and other information address

D. GORDON LAMB, *Secretary,*
819 Chamber of Commerce Bldg.,
Indianapolis.

NEW JERSEY STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY

THE State Board of Registration and Examination in Dentistry in New Jersey will hold its next examination commencing April 4, 1943 and continuing for five days. Upon application to the secretary, a copy of the requirements and rules, instruction sheet and preliminary application will be sent. Any person desiring to apply as a candidate must file the preliminary application blank, together with the examination fee of $25, on or before February 15.

WALTER A. WILSON, *Secretary,*
150 E. State St.,
Trenton.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the North Carolina State Board of Dental Examiners for the examination of applicants for licensure will be held at the state capitol, Raleigh, beginning April 5, 1943. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information, address

WILBERT JACKSON, *Secretary,*
Rich Building,
Clinton.

DENTAL COUNCIL AND EXAMINING BOARD OF THE COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will meet in Philadelphia and Pittsburgh, February 16-20, 1943, to examine applicants for license to practice dentistry. Owing to the acceleration of the courses, no examinations will be held at this time for a dental hygiene license. For further information and application blanks, address the Department of Public Instruction, Bureau of Harrisburg.

REUBEN E. V. MILLER, *Secretary,*
61 N. Third St.,
Easton.

TEXAS STATE BOARD OF DENTAL EXAMINERS

THE Texas State Board of Dental Examiners will hold its next examination December 7-10 in Dallas. Applications must be filed at least ten days prior to the date of examination. For further information, address

CARL C. HARDIN, JR.,
Executive Secretary,
520 Littlefield Bldg.,
Austin.

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

THE next regular meeting of the Virginia State Board of Dental Examiners will be held at the Medical College of Virginia, Richmond, beginning at 9 a.m., March 30, 1943. Each applicant will be required to present a certificate from the Virginia State Board of Education, State Office Building, Richmond, showing that he has had at least one year of academic education equal to one year of college work. He must be a graduate of a Class A dental college and must be prepared to do any kind of practical or operative work necessary to the general practice of dentistry. The theoretical examination covers subjects usually found in a complete dental curriculum. Incomplete applications will be returned. No applications will be accepted after March 20. For application blanks and further information, apply to

JOHN M. HUGHES, *Secretary*
715 Medical Arts Bldg.,
Richmond.

WEST VIRGINIA STATE BOARD OF DENTAL EXAMINERS

THE West Virginia State Board of Dental Examiners, recognizing the fact that the American Dental Association has not approved any schools for the training of dental hygienists, has decided to register and approve all schools operating in the State of West Virginia graduates of which intend to be applicants to practice dental hygiene in this state. The educational requirements for approval are: (1) The school shall be accredited by the West Virginia State Board of Education and shall grant degrees on its authority. (2) Its graduates shall be approved for teaching in high schools holding membership in the North Central Association of Colleges and Secondary Schools. (3) The course of study shall cover a period of not less than two years of at least nine months each during which time the student shall have completed a minimum of sixty-four semester hours. (4) The minimum course of study of each of the following subjects shall be two semester hours; (a) anatomy and dental anatomy; (b) physiology; (c) dental histology; (d) bacteriology; (e) sterilization; (f) dental caries; (g) malocclusion; (h) radiography. (5) The course of study of oral prophylaxis and clinical practice shall be a minimum of sixteen semester hours' credit. Applicants from schools out of the state shall be required to present evidence that their school meets equivalent educational standards.

RESIDENCY IN DENTAL MEDICINE

THE University of Oregon Medical School Hospitals and Clinics offer a residency in the Division of Dental Medicine and Oral Surgery. Appointment will be made about December 1. The period of service is one year, from July 1 to June 30; compensation $40 a month in addition to board, room and laundry. The division is under the general direction of the department of medicine. Its service is carried on in several units: (1) the general outpatient clinic; (2) the Multnomah Hospital; (3) the Doernbecher Children's Hospital, and (4) the University State Tuberculosis Hospital. Service is under the direct supervision of the head of the division and a visiting staff of sixteen dentists. Applicants should indicate their previous training and major interest in one or more of the

following subjects; (1) research; (2) clinical medicine; (3) exodontia and oral and plastic surgery; (4) radiography, and (5) restorative dentistry. Inquiries should be directed to

RICHARD B. DILLEHUNT, *Dean*,
University of Oregon Medical School,
Portland, Ore.

RESEARCH FELLOWSHIPS IN MEDICINE, DENTISTRY AND PHARMACY, UNIVERSITY OF ILLINOIS, 1943-1944

APPLICATIONS for research fellowships in medicine, dentistry and pharmacy in the University of Illinois are now being considered for the year beginning September 1, 1943. Appointments to these fellowships will be announced January 1, 1943. Candidates for these fellowships must have completed a training of not less than eight years beyond high school. The fellowship carries a stipend of $1,200 per calendar year with one month's vacation. Application blanks and further information can be secured from the secretary of the Committee on Graduate Work in Medicine, Dentistry and Pharmacy, 1853 W. Polk St., Chicago, Ill.

CARNEGIE FELLOWSHIPS FOR RESEARCH AND GRADUATE WORK IN THE DENTAL SCIENCES

AIDED by the Carnegie Corporation of the New York and the Eastman Dental Clinic, the School of Medicine and Dentistry of the University of Rochester offers scholarships paying $1,200-$1,800 per annum to well-trained dental graduates who are interested in research or who desire special training in the basic medical sciences as an aid to dental teaching or practice. A few fellowships also offer part-time training in oral surgery. On appointment, the applicant is given the title of Fellow in Dentistry and, according to his interest, works as a graduate student in one of the departments of the medical schools. Here, excellent laboratory facilities, adequate direction and close contact with various investigations related to medicine and dentistry help his research and study. Fellows are encouraged to attend medical classes, seminars and staff meetings and, when opportunity presents itself, to participate in class instruction and scientific meetings. Contact with the problems of clinical dentistry may be maintained through the Oral Surgery Clinic of the Strong Memorial Hospital and the Rochester Dental Dispensary. With the approval of the Graduate Council of the university, Fellows may prepare themselves for the degree of M.S., or Ph.D. Applicants should be made to

GEORGE H. WHIPPLE, *Dean*,
School of Medicine and Dentistry,
Rochester, N. Y.

NEW YORK UNIVERSITY COLLEGE OF DENTISTRY POSTGRADUATE COURSE

THE New York University of Dentistry announces a postgraduate course in inhalation anesthesia, with special emphasis on nitrous oxide-oxygen anesthesia, conducted by E. A. Rovenstine, professor of anesthesia, N. Y. U. College of Medicine and Bellevue Hospital, and A. S. Mecca, assistant professor of oral surgery, N. Y. U. College of Dentistry and Bellevue Hospital. The course will be given on Friday mornings October 2 to November 6 inclusive. Direct all communications to the office of the dean, N. Y. U. Dental College, 209 E. 23rd St., New York, N. Y.

COLUMBIA UNIVERSITY COURSE FOR ORTHODONTISTS

THE School of Dental and Oral Surgery of Columbia University announces an intensive theoretical and practical course for orthodontists, under the direction of Joseph E. Johnson, assisted by Joseph D. Eby, Henry U. Barber, Jr., George B. Crozat, Clare K. Madden, Franklin A. Squires and Charles A. Spahn, December 6 to 12. The course will consist of lectures and technical training in the construction of bands, the lingual arch and the twin wire mechanism. A second course, under the direction of Robert H. W. Strang, assisted by Will H. Thompson, Jr., and Glenn H. Whitson, is announced for January 17-30, 1943.

Admission to the course is limited to members in good standing of the American Association of Orthodontists or of generally recognized sectional organizations of orthodontic specialists in America and foreign countries, or those who have passed the American Board of Orthodontics. For further information, address the Assistant to the Registrar, School of Dental and Oral Surgery, 630 West 168th St., New York, N. Y.